Application of Well-seismic Combination Technology in Tapping the Potential of Remaining Oil

Longhong Xu

Institute of Geology, No.10 Oil Production Plant of anniversary Oilfield Co., Ltd., 163312, China

Abstract. Combined with the characteristics of well pattern with high density and abundant dynamic and static data, the application of well-seismic technology in tapping the potential of remaining oil can improve the exploitation level of remaining oil. Through fine structural interpretation and hierarchical method, the practical application of well-seismic combination technology is discussed. Well-seismic combination depicts sedimentary facies, analyzes sand body characteristics, uses fine digital reservoir simulation to analyze remaining oil distribution characteristics, and studies the tapping process of different types of remaining oil, providing technical support for the next development adjustment and scheme optimization.

Keywords: Well-seismic combination technology, Residual oil, Potential tapping process.

1. Introduction

Based on geology and logging sedimentary facies, combined with earthquake prediction structure, well-seismic combination technology analyzes and studies sedimentary environment and sedimentary facies types, and draws facies belts of each sedimentary unit. In tapping the potential of remaining oil, making full use of well seismic combination technology to analyze the distribution characteristics and reservoir structure can improve the level of well pattern construction and promote the stable and innovative development of oil production [1].

2. Analysis of sedimentary facies characteristics combined with well seismic

2.1 Analysis of sedimentary facies characteristics

Based on the geological and logging sedimentary facies, combined with the seismic analysis results, the sedimentary environment and sedimentary facies types are analyzed, and the facies belt diagram of sedimentary units is drawn [2]. Seismic waveform feature inversion can integrate seismic, geological and logging information with the application of Bayesian model through the idea of phased random simulation. Using seismic information, high-frequency simulation of oil and water well parameters can be used to analyze the change of reservoir spatial structure by using seismic waveform characteristics instead of variogram function, which can improve the lateral resolution, and improve the accuracy and reliability of reservoir prediction. It is especially suitable for the high-precision prediction environment of oil reservoirs with fast lateral change, strong heterogeneity and thin interbeds [3].

Drilling-seismic joint depiction of sedimentary facies belt map is to use seismic inversion slice, profile, well-seismic combined sandstone and effective sandstone thickness map to supplement the information between oil and water wells, and to jointly depict the spatial distribution of sand bodies in different sedimentary facies belts with drilling information. In the statistics and analysis of comprehensive information, it is convenient to draw sedimentary facies zones between oil and water wells by using sandstone thickness map and effective sandstone thickness map, and the distribution of plane strike is controlled by sedimentary microfacies model and plane shape of inversion slice [4]. Combined with seismic attributes and reservoir inversion results, the well seismic joint characterization of 26 sedimentary unit facies belt maps and the comparison of new and old facies belts can improve the fineness and intuitively and accurately analyze the directional distribution characteristics of sand bodies. The specific well connection profile is as follows:

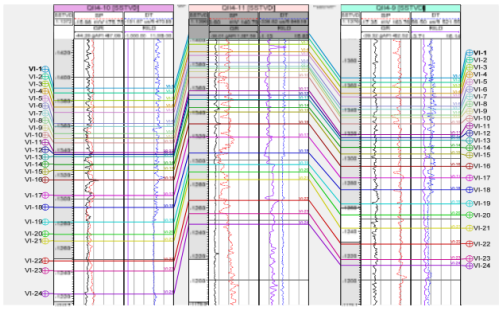

Figure 1 Sectional view of connecting wells

The accuracy of well-seismic combination can be improved by pulling off the well-connected profile of a single well, and the seismic data and logging stratification data can be tested, so as to improve the accuracy and effectiveness of the remaining oil tapping inspection and analysis [5].

2.2 Seismic attribute extraction and Application

From the perspective of application of well-seismic technology, seismic attributes of oil and water wells can be extracted, and reservoir parameters of the block can be interpreted and analyzed. Combined with the sensitivity of seismic attribute parameters to reservoir changes, the seismic attributes are emphatically analyzed, and the reservoir distribution range of remaining oil is comprehensively predicted. In the statistics and analysis of the changing trend of oil and water wells, it is necessary to integrate the parameters of oil and water wells and seismic parameters. After fault modeling, the spatial combination of faults, faults, fault occurrence and so on can be analyzed, and the distribution inspection and analysis of remaining oil reservoirs can be realized. Under the application of well-seismic combination technology, the fine tracing process of remaining reservoirs can be optimized, and through the analysis of amplitude change, the characteristics of sedimentary facies can be inspected and analyzed [6].

Inversion of sand body contour map and seismic attribute slice can clearly reflect the outline and continuity of the main sandstone in the sub-layer, and observe the macroscopic combination of sand bodies. Inversion data can obtain the equivalent map of sand bodies and the single-layer accumulation information reflected by seismic attribute slices, which can reflect the information of sand bodies in sedimentary units, but can not accurately reflect the width of cross-well sand bodies and the connectivity between sand bodies. The comprehensive control level of well seismic combination can be improved by extracting multiple slices along the layer in the sedimentary unit and optimizing and analyzing the slices according to the sedimentary facies diagram.

2.3 Application effect analysis of well seismic combination

Seismic inversion is to analyze the geological law, drilling and logging data by means of surface observation, and to inspect and treat the state of oil and water wells by stages through single sand body identification. Under the analysis of seismic data, the sedimentary microfacies of oil and water wells can be counted and analyzed, and from the perspective of slice data analysis and processing, the level of remaining oil tapping can be improved. Through the application of well-seismic combination, the ranging boundary and seismic identification image of a single channel boundary in composite sand body can be established, and the distribution and processing level of oil and water wells can be improved through the inspection of spatial distribution characteristics. From the perspective of seismic data characteristics and reservoir information analysis and processing of oil and water wells, sedimentary microfacies can be divided, sand body shape and scale can be corrected, and the level of data analysis and processing can be improved. Combined with the structural characteristics of the study area, the interlayer contradiction is prominent and the well condition is relatively complex. Taking the combination of well and earthquake as the center, analyzing the geological environment and strengthening the potential tapping process can accumulate 7647t of oil, and the potential tapping effect of complex fault blocks is remarkable. However, in practical application, faults in the block are very developed, which leads to unclear understanding of oil-water well structures. Affected by reservoir heterogeneity, the contradictions among layers, layers and planes in the block are prominent, and the flooding of oil wells is serious, with the comprehensive water content as high as 90.31%. With the development of oil field, the condition of oil and water wells has deteriorated seriously, casing deformation and falling wells are increasing day by day, and there are many downhole accidents in the statistical block, which leads to imperfect local injection-production well pattern and affects the development level of oil and water wells.

3. Application strategy of well seismic combination technology in tapping potential of remaining oil

3.1 Analysis of distribution characteristics of remaining oil

The main controlling factors of macro-remaining oil distribution are geological factors and development factors. Among them, geological factors include structure, reservoir, fluid, etc., and development factors include well pattern perfection, well pattern interference, perforation perfection, oil recovery rate, etc. Combining the structure, fluid properties and well pattern structure of remaining oil layers in the study area, the evaluation of cross-well interference and reservoir heterogeneity can improve the level of tapping potential. From the perspective of plane layout of the study area, the distribution of remaining oil is directly related to water invasion direction and cross-well interference. Therefore, in the sedimentary stage, the base level rises, the sedimentary microfacies are mainly mixed flat, and the lateral margin of banded flat is locally developed, with heavy mud content, poor reservoir physical properties, average permeability of 150mD and well-developed mudstone interlayer. During the

deposition period of the second sublayer, the base level rose but reversed, and the reservoir was still dominated by mixed flat, and the range of sand flat expanded. However, it was discontinuous, and the whole reservoir was dominated by medium permeability, with an average permeability of 200-300mD, and calcareous interlayer developed. Due to the well-developed longitudinal interlayer, the interior of each sublayer is still dominated by edge water propulsion, but the degree of flooding in different well areas is quite different. Therefore, with the combination of well logging and seismic technology, the production profile can be optimized to improve the vertical production, and the wellbore conditions can be optimized to improve the control level of remaining oil distribution.

Through the application of well logging and seismic technology, the sedimentary facies belt map can be analyzed, and the distribution characteristics of remaining oil can be tested by modeling and numerical analysis. The remaining oil in the study area is highly scattered and locally enriched, including areas with relatively high abundance of remaining oil and concentrated distribution of narrow bands of remaining oil, which is directly related to the control of the original oil-water interface. Therefore, the remaining oil distribution will be counted in the minutes of simulation by combining well logging with seismic technology. The remaining oil is mainly concentrated in the main channel, shallow channel, non-main sheet sand and underwater distributary microfacies with wide distribution area, accounting for 72.38% of the total remaining reserves. The recovery degree of main river channel, transitional zone channel and main sheet sand is relatively high, while the recovery degree of shallow river channel and lens is relatively low. The remaining oil distribution potential is mainly concentrated in sandstone layer, and the recovery degree of sandstone layer is relatively high.

3.2 Analysis of potential tapping process

On the whole, it is related to injection-production well pattern, fault and micro-amplitude structure. Considering the structural type, distribution direction of sand bodies and injection-production relationship, the potential tapping mode of river channel and sheet sand can be adjusted, which is helpful to improve the potential tapping level of oil and water wells.

3.2.1 Potential tapping model of underwater distributary channel sand body

Micro-structure-injection and production, the remaining oil is concentrated in the structural high point, and the remaining oil reserves are relatively rich. By means of water well subdivision and profile control, the oil well can be located, and the potential can be tapped after fracturing, so as to improve the potential tapping operation level of micro-structure.

No trap-injection without production, the remaining oil is mainly concentrated in the local part of the river channel, and the remaining oil reserves are relatively small. Therefore, in actual operation, it is necessary to increase the injection of water wells to improve the efficiency of water flooding.

Forward fault-with injection and production, the dip of upper and lower wall strata is consistent with the dip of cross section, which is a forward fault. The remaining oil is concentrated at the edge of the river fault, and the remaining oil is relatively rich, which can be tapped by oil well fracturing and plugging.

Reverse fault-injection and production, the dip of upper and lower wall strata is opposite to the dip of cross section, which can optimize the process of tapping the potential of remaining oil. Considering the enrichment state of remaining oil, tap the potential by water well subdivision, well pattern infilling and oil well fracturing.

3.2.2 Potential tapping model of sheet sand body

Mat-shaped sand is generally relatively perfect in injection and production, and there are few types of no injection and no production. Therefore, in the specific process of tapping potential, the specific operation mode is as follows:

Micro-structure-production without injection, the remaining oil is concentrated in the high-power point of the structure where the micro-structure is located, and the remaining oil is rich, which can be tapped by means of well pattern encryption and adjustment of injection-production system.

There is no trap-there is production without injection, and the remaining oil is mainly concentrated in the middle area of sand body, with detention, and the remaining oil is rich. By means of well pattern encryption, the oil well is fractured and then tapped.

Fault-injection and production, the remaining oil is mainly concentrated at the edge of the fault, and the remaining oil is relatively rich. Therefore, by means of water well subdivision and profile control, the well pattern infilling and oil well fracturing can be tapped to improve the application effect of well-seismic combination technology in tapping potential.

3.3 Strengthen the combination of well and earthquake and implement the fault block structure

From the perspective of development trends and structures in the study area, the difficulty of tapping the potential of remaining oil is evaluated. According to block logging, logging and other data, the sedimentary characteristics are analyzed, and by means of standard layer control and analysis, dynamic data are used to carry out the fine stratigraphic correlation study in the whole area, and the stratigraphic framework of the study area is established, and oil and water wells with deep drilling and accurate logging data are selected for seismic record statistics. At the same time, combined with logging core data, identify the regional marker layer, obtain the relationship between velocity curve and time depth, calibrate the comprehensive horizon of single well and connected well, and determine the fault trend. On the basis of horizon calibration, the reservoir profile is described, and the remaining oil reservoir characteristics

of oil and water wells are obtained. Through the fine geological study of fault block, on the basis of re-implementing the fault block structure, the hidden parts of fault, structural high points and remaining oil-rich areas between oil and water wells are summarized and screened to tap potential layers, so as to improve the stable production basis of the block.

3.4 Risk control of tapping potential

In combination with the structural complexity of oil and water wells in the study area, the interlayer contradiction is prominent and the backup layer is scarce. Using the technology of well-seismic combination, the inspection and analysis of remaining oil distribution characteristics are carried out. Combined with geological basis and production performance of oil and water wells, well-seismic combination analysis is carried out on a well group by well group basis, and multi-well connected seismic profiles are drawn, so as to comprehensively and objectively control the plane distribution law and scope of reservoirs, optimize sand body areas and draw well connected seismic profiles in well groups in the target area. Comprehensively analyze the distribution range and potential change of remaining oil in different target areas, wells and layers, and accurately lock the potential sand bodies. At the same time, combined with dynamic data and monitoring data of oil and water wells, well-seismic combination and well-seismic calibration are adopted to reduce potential tapping risk and improve potential tapping control level on the basis of ensuring economic efficiency. According to the working idea of "combining dynamic and static data, well-seismic comparison and deepening geological understanding", we should strengthen the research on the distribution law of remaining oil, improve the vertical resolution and accuracy of well-seismic combination of oil and water wells, deepen the distribution law of remaining oil, establish an effective tapping scheme and ensure the application effect of well-seismic combination technology in tapping the potential of remaining oil.

4. Conclusions

By using the combination method of well seismic and breakpoint, the remaining oil can be analyzed by multi-angle and multi-data, and the level of remaining oil tapping analysis can be improved. Through data modeling and analysis, the geological environment, sand body characteristics and other parameters are analyzed, and the remaining oil distribution is determined through reservoir simulation and analysis. The application of well logging and seismic technology can accurately scan and predict the process of tapping the potential of remaining oil. Through seismic waveform indication inversion, the high-frequency simulation of well parameters by means of random simulation can improve the accuracy and reliability of reservoir prediction. Combined with seismic attributes and reservoir inversion results, well seismic joint characterization of sedimentary unit facies belt map is helpful to accurately describe the directional distribution of sand bodies and improve the application level of well seismic combination technology in tapping the potential of remaining oil.

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