Establishment of high-resolution sequence stratigraphic framework of Putaohua Reservoir in Puxi Oil field

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Abstract：In the background of shallow water delta front facies, the reservoir of study area is affected by the river and wave double force. The continuity of sand is poor. The difficulty of correlation presents many ways. Such as the lack of maker bed in Putaohua Reservoir, unconspicuous distinction of correlation, interferred by spin echo deposition of underwater distributary channel, the change in the pattern of stacked sands, the division of classes of base level cycle. Based on the principle of high-resolution sequence stratigraphy, the ways of correlation and using core data, analysis and test data, logging data, seismic data establish high-resolution sequence stratigraphic framework, which is of great significance to guide the development and production of oil field.

Key words：*Puxi oil field, Putaohua reservoir, High resolution sequence stratigraphy, Methods of stratigraphic correlation*

I. INTRODUCTION

Geographical location in the study area is located in Zhaoyuan country and Duerbote monggol nationality autonomous county in the Daqing city of Heilongjiang province. Tectonic position is located in the Puxi nose-like structure of the central depression area, southern Qijia-Gulong depression in Songliao basin.The purpose of the study Putaohua Reservoir belongs to Yao group sedimentary formation with large lake delta front deposition. Oilfield has entered the late development stage, and urgently needs to understand the underground geological conditions. High resolution sequence stratigraphic framework offer compacted geological foundation [1].

II. STRATIGRAPHIC CLASSIFICATION OF HIGH RESOLUTION SEQUENCE

Based on the basic principle of high resolution sequence stratigraphy and the interface feature of base-level cycle of different classes , Putaohua Reservoir in Puxi oilfield is divided into 2 middle-term base-level cycles, 11 short-term base-level cycles and 15 short-term base-level cycles (Fig.1).

Fig1 The division of standard well of Putaohua Reservoir in Puxi oil field

III. STRATIGRAPHIC CORRELATIONS OF HIGH RESOLUTION SEQUENCE

Based on high-resolution sequence stratigraphic classification, usually by means of the theory of high resolution sequence stratigraphy the stratigraphic correlation can be finished. But not all of the base level cycle in the study area is obvious and can be easy to identify the characteristics in logging curve, stratigraphic correlation methods in the aid of delta depositional system is necessary. Such as the correlation of the maker bed control, base level cycle correlation, the sedimentary characteristics of underwater distributary channel, balance thickness method, the mode of fault guiding the contrast, closed frame section [2-3]. By the correlation methods, a uniform and accurate isochronous stratigraphic framework has been established.

3.1 The correlation method of maker bed control

Through the analysis, six layers with the sigh of the stability are found in the study area. Maker bed one, two is respectively about 15m、6m from Putaohua Reservoir top of the silt layer with distribution of stability. Gamma curve has high value and resistivity curve has low value. Genesis of the phenomenon is in disruption the stability of the quiet water in flooding period, thin sand layer is in mudstone. Maker beds three and four is respectively the top of Putaohua reservoir and bottom of Putaohua Reservoir with the growth rate of 100%. Maker beds five, six are located in the lower part of Putaohua Reservoir, and the characteristics and causes is the same as the maker bed one and two. Above, maker beds have the stable characteristics in distribution of the whole study area and deposit at the same time. These maker beds can accurately determine the Putaohua Reservoir in the position of vertical formation during the correlation (Fig.2).

3.2 The correlation of different classes of base-level cycle [4-5]

Different classes of base level cycle result in different classes of base-level cycle sequence. During the process of correlation, middle-term base-level cycle sequence regard as comparison framework, and then the short-term, super short-term base-level cycle sequence is contrasted.
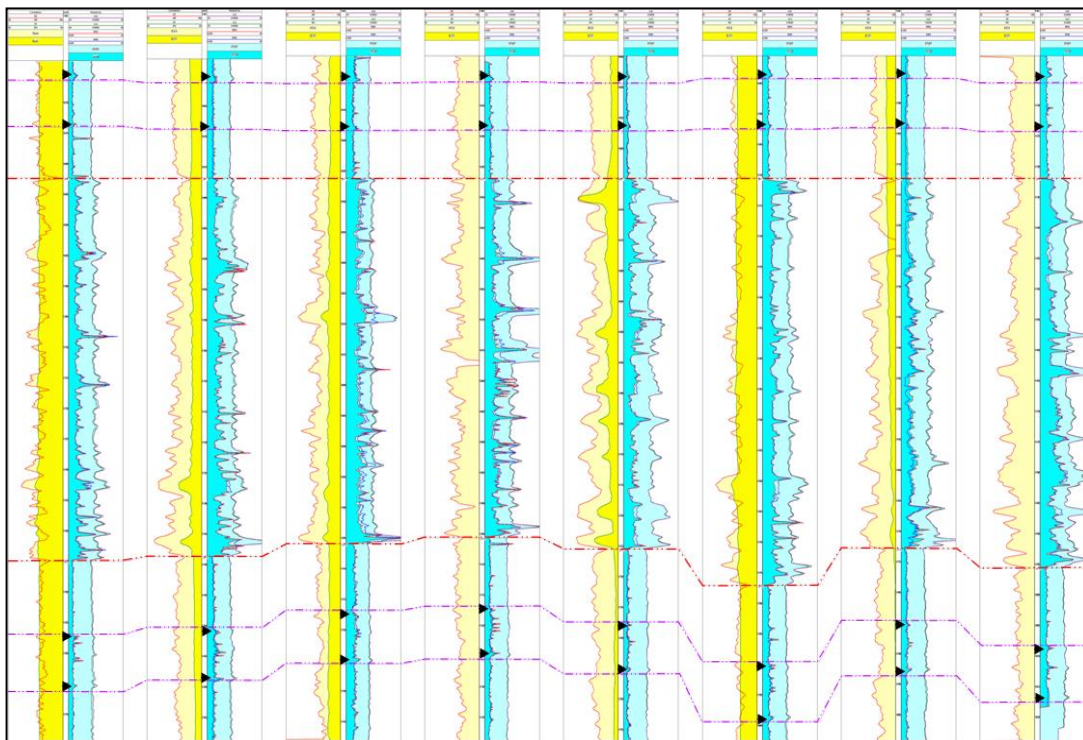

Fig 2 The correlation of maker bed of Putaohua Reservoir in Puxi oil field

3.3 The correlation of balance thickness method

The cutting action make the scour surface uneven at the bottom of the river channel and the river has different thickness in different positions .The balance thickness is average thickness of sedimentary body of river. Specific steps: firstly, determine the thickness of the balance of the depositional time unit. Second, the bottom interface of the channel sand body which is close to balance thickness would be regarded as the line of contrast. Finally, the interface of the balance thickness applies to the adjacent wells, which can control the strata, where base level cycle is not obvious.

3.4The correlation of mode of fault

The existence of the fault makes the absence of strata of the well which drill in the fault. How to determine the breakpoint becomes the key word of the well which drills in the fault. Taking an example illustrate the well G106 which drills in fault. G106 is close to G108.The formation of G106 is partly missing, but the maker bed is present. The thickness of purpose layer in study area is about 60 meters, but the thickness of purpose layer of G106 is 24.5 meters with the loss of 35.5 meters. According to the similarity of curve shape, correlation of strata begins from the bottom maker bed up to the top of Putaohua Reservoir compared with G108. And then correlation of strata begins from the top of the maker bed down to the bottom of Putaohua Reservoir compared with G108 (Fig.3a). By the correlation of strata, G106 miss the middle part of Putaohua Reservoir. By the analysis of seismic section (Fig.3b), G106 is located in hanging wall of fault, and the result of missing formation is the same compared with the result of correlation with log.
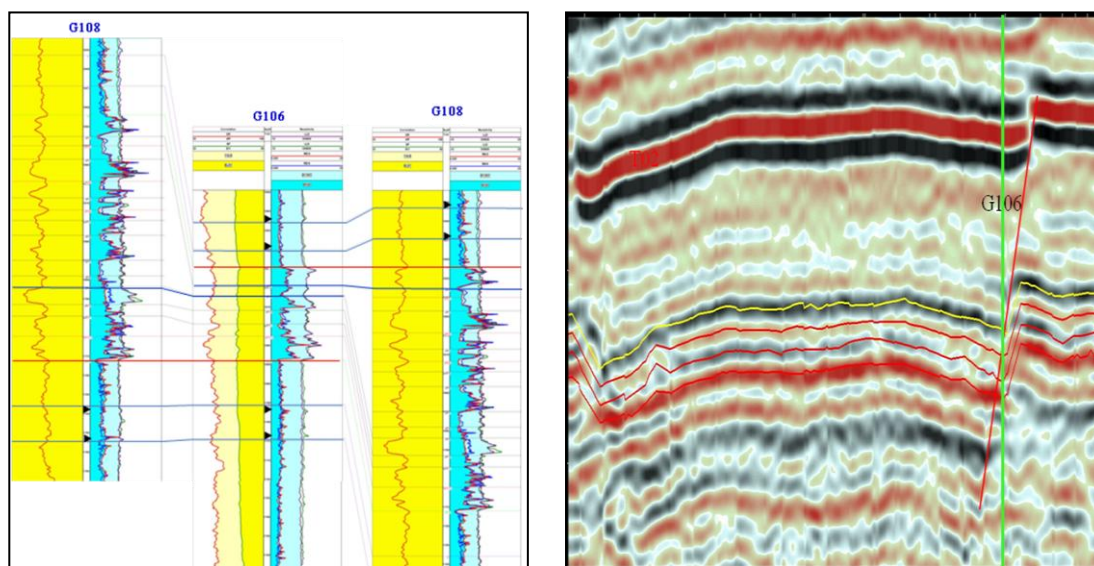
a The correlation of fault wells　　　　　　　　b The seismic section of G106

Fig 3 The correlation of well-off of Putaohua Reservoir in Puxi oil field

IV.　　THE VERIFICATION OF THE RESULT OF CORRELATION

The results of comparison will directly affect the sedimentary microfacies of drawing and the study of the connectivity of reservoir .According to the gravity differentiation, oil is located in the high structural position in the same system of oil and water, and water is located in the lower part .Through reservoir section and faces sequence, the accuracy of the isochronous stratigraphic framework can be checked up. Now taking PI7 depositional time unit as an example, map sedimentary microfacies plan (Fig.5A), which fits a pattern of shallow water delta front deposition. Fluid in connected sand body accords with the distribution law of reservoir by means of the study of sedimentary microfacies and the tectonic position from low to high in reservoir section (Fig.5B), so the validity of the contrast is verified.
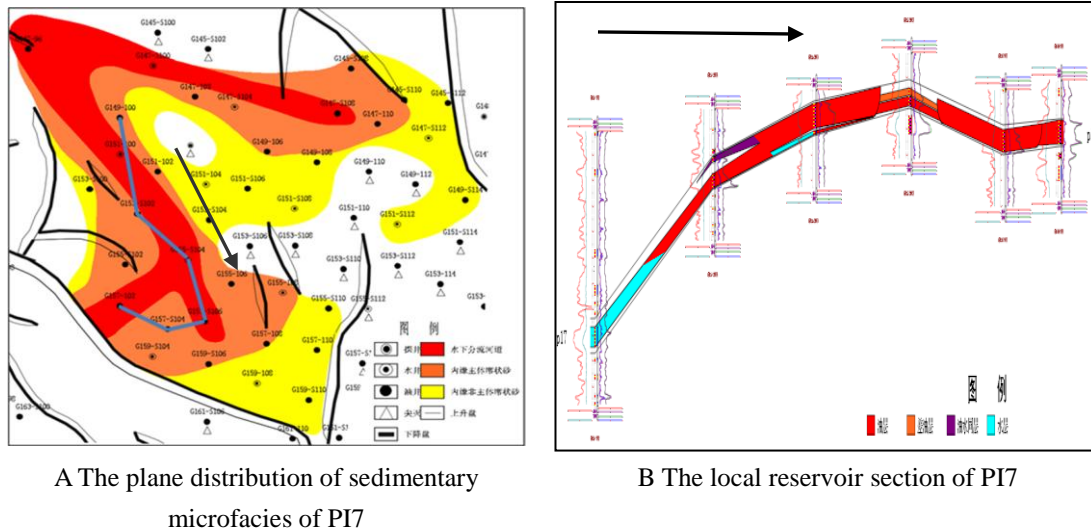
A The plane distribution of sedimentary microfacies of PI7

B The local reservoir section of PI7

Fig 4 Partial sedimentary facies and reservoir section of Putaohua Reservoir in Puxi oil field

V. CONCLUSIONS

1 Based on the theory of high-resolution sequence stratigraphy, combined with the feature of the base level cycle, the Putaohua Reservoir in Puxi oilfield is divided into 2 meddle-term base level cycle, 11 short-term base level cycles and 15 super short-term base level cycle.

2 Isochronous stratigraphic frameworks has been established of Putaohua Reservoir in Puxi oil field by using the control of maker bed constraint, balance thickness methods, different classes of base-level cycle, and mode of fault.

3 Plan of sedimentary microfacies and reservoir profile verify the reliability of high-resolution stratigraphic framework, which has achieved remarkable achievement. A strong geological basis has been provided in the late oilfield development.

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