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The research of sedimentary facies of H3Ⅳ5 member in the wang 9 area

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Abstract: On the basis of geological drilling, logging and thin section analysis, combining with detailed rock core observation and descriptions, we studied sedimentary facies of H3Ⅳ5 member in the Wang 9 area. According to particle size and thin section analysis, there is fine sandstone and siltstone in the member at most. On the basis of rock core observation, conducting phase analysis of single coring well, we identified the interval as delta which developed delta front and front delta subfacies, including seven types of microfacies which are underwater distributary channel, mouth bar, underwater overbank sand, sand sheet, split between underwater distributary channel, the former delta mud and turbidite sand. A variety of typical microfacies phase model logging were built. All of the single facies analysis of non-coring wells. Three sections of sedimentary microfacies and the plane sedimentary microfacies graphs of Ⅳ5 member of formation were draw. The northern Wangji delta and eastern Houzhuang braided river delta were the major source of the work area.

Key words: *sedimentary facies; delta front facies; phase analysis of single well; plane phase*

I. INTRODUCTION

Wangji field is located in the northeast of the north slope of Biyang sag, which is a broad and gentle nosing structure plunging to deep sag area in the south[1-2]. This is a thin oil reservoir that is waterflooding and has complex fault block[3-4]. The geologic reserve is 974.5×10^4t, the available reserve is 268.1×10^4t, the degree of reserve recovery is 13.7%, the composite water cut is 78.61%. Since 1977 putting ino production, development phase has been the middle-high containing water after more than 30 years of development. Since 2002, well pattern was adjusted many times, Wangji field production has been gradually rising trend.

Recent research shows that there is a large exploration potential in Wangji field, especially that the oil and gas of He San period has lower proved rate and has great potential in space[5]. In this paper, in view of the present problems existing in the work area production, the rich logging data in combination with a limited number of coring data, logging trace which apply to sedimentary microfacies in Wangji region was discussed, and the application is better to understand that sedimentary facies control the distribution and collection of oil and gas.

II. TYPICAL PHASE ANALYSIS OF SINGLE WELL AND SEDIMENTARY MICROFACIES MODEL

2.1 Phase analysis of single coring well

Analysing the sedimentary facies of observed cores section is the basis of sedimentary facies analysis by using logging trace. Through the analysis of sedimentary facies of observed cores section, sedimentary facies, subfacies and microfacies in the study area can be determined, and the corresponding relationship between lithology and electric can be established, typical sedimentary microfacies and electrofacies model can be built. Moreover, the analysis of sedimentary facies lay a foundation for dividing the region's sedimentary microfacies by taking advantage of logging trace. On the basis of rock core observation, conducting sedimentary facies

analysis, we identified the interval as delta which developed delta front and front delta subfacies, the main sedimentary microfacies of sand body are underwater distributary channel, mouth bar, underwater overbank sand, sand sheet.

2.1.1 Phase analysis of single coring well of Bi 146 well

Located in the north in the study area, the well coring interval of 744-819m, coring layer for the $H3Ⅳ5^1$-$H3Ⅳ5^4$, the whole well developed sandstone, lithology and electric characteristics is significant.

Here are the main lithologies of coring segments: the upper lithology is gray conglomerate, pebbled sandstone, gritstone, fine sandstone, siltstone, gray mudstone and variegated mudstone; the lower lithology is dark gray mudstone, charcoal grey mudstone, taupe shale, gray fine sandston, hoary fine sandston and gray siltstone. There are erosion and stuffed structure.

$H3Ⅳ5^1$ member: Lithology is mainly taupe shale, gray shale, hoary fine sandston, and gray anisomerous sandstone. Sand thickness is thin, and the type of logging trace is dactyline. The sedimentary microfacies are underwater overbank sand and the former delta mud.

$H3Ⅳ5^2$ member: Lithology is mainly gray shale, silty mudstone and pelitic siltston. Sand thickness is very thin, and the type of logging trace is dactyline. The sedimentary microfacies are underwater overbank sand and the former delta mud.

$H3Ⅳ5^3$ member: Lithology is mainly gray shale and anisomerous sandstone. Sand thickness is very thin. The sedimentary microfacies is mouth bar.

$H3Ⅳ5^4$ member: Lithology is mainly gray oil flecked fine sandstone, gray oil soaked fine sandstone, gray oil soaked siltstone and gray mudstone. Sand thickness is large, and the type of logging trace is box. The sedimentary microfacies is underwater distributary channel.

2.1.2 Phase analysis of single coring well of Wang 977 well

Located in the north in the study area, the well coring interval of 988-1004.4m, coring layer for the $H3Ⅳ5^1$-$H3Ⅳ5^3$.

Here are the main lithologies of coring segments: The upper lithology is gray oil flecked siltstone, gray oil flecked fine sandstone, gray mudstone, gray siltstone and gray fine sandstone; the lower lithology is gray oil traced fine sandstone, gray siltstone, gray fine sandstone and gray mudstone. There are swaley cross stratification, erosion and stuffed structure, rumpled structure.

$H3Ⅳ5^1$ member: Lithology is mainly gray oil flecked siltstone, oil flecked fine sandstone, anisomerous sandstone and gray mudstone. Sand thickness is thin, and the type of logging trace is dactyline. The sedimentary microfacies are underwater distributary channel and the former delta mud.

$H3Ⅳ5^2$ member: Lithology is mainly gray mudstone, oil traced fine sandstone, gray siltstone and gray fine sandstone. Sand thickness is thin, and the type of logging trace is campaniform. The sedimentary microfacies are underwater distributary channel, the former delta mud and sand sheet.

$H3Ⅳ5^3$ member: Lithology is mainly gray mudstone. The sedimentary microfacies is the former delta mud.

2.2 Typical sedimentary microfacies model and electrofacies model

On the basis of detailed rock core observation and descriptions, various sedimentary microfacies of facies marks and phase analysis of single coring well, selecting typical vertical profile of the same microfacies of each well, the sedimentary microfacies model and electrofacies model can be built.

2.2.1 Delta front subfacies

Delta front subfacies is a zone where delta sand intensively developed, including five types of microfacies. What follows is the sedimentary feature of these microfacies.

(1) Underwater distributary channel microfacies

Underwater distributary channel is the extended part of overwater distributary channel under water. The lithology of sediment is mainly brown, taupe and gray pebbled sandstone, sandstone, siltstone, transitional lithology. The lithology shows positive rhythm. It is developed festoon cross-bedding, plate oblique bedding and wave bedding, etc (Figure 1).

The feature of electrofacies: The shape of SP curve is box and high flat bell, the bottom is abrupt contact, the top is gradual and abrupt transition. The shape of microelectrode curve shows bell, tooth bell or box, the upper separation of scope is small, the under is large, and the bottom is abrupt contact, the top is gradual contact.

(2) Underwater overbank sand microfacies

Underwater overbank sand located in the both sides of underwater distributary channel. Generally sand body of the ceter is thin and on each side of the river is thick. The lithology is mainly greyish-green and gray siltstone, argillaceous sandstone, mudstone, pelitic siltston. It is developed minute cross bedding, wave bedding, flat bedding. There is bur and stir structure (Figure 1).

The feature of electrofacies: The amplitude value of bore log is medium-high, and the separation of amplitude is zero-medium. These show that it is a product of low-energy environment. The shape of bore log is dactyline or flat bell peak, caught in underwater distributary channel. And the bottom is abrupt contact, the top is gradual contact.

(3) Mouth bar microfacies

It is located in the estuary of underwater distributary channel and river bifurcation. The lithology is mainly gray and hoary sandstone, siltstone including pelitic siltston. There is developed festoon and ripple lamination, interrupted wave bedding, sometings we can see clay band and deformation structure. The size is coarsening-upward, this is called inverted rhythm.

The feature of electrofacies: The value of SP curve is significantly negative with inverse cycle. The amplitude value of microelectrode curve is high, and amplitude separation is medium-high, the shape of curve shows funnel or tooth funnel. The top is abrupt contact, and the bottom is gradual contact.

(4) Sand sheet microfacies

There are fine sandstone, siltstone, pelitic siltston, and thin alternate layer that Silty mudstone interbedded with mudstone deposited. Single sand thickness is generally less than 2m, rhythm is not obvious. flat bedding develops in mudstone. Wave and deformation bedding are often visible in the transition lithology (Figure 1).

The feature of electrofacies: Curve shape is finger-like pike between two flat curve. The value of SP curve is negative. The amplitude value of microelectrode curve is middle, amplitude separation is also middle. In addition, the top is abrupt contact.

(5) Split between underwater distributary channel microfacies

It deposits between the underwater distributary channel. Lithology is formed by greyish-green mudstone, pelitic siltston and siltstone. Mudstone general is massive. Bur structure is visible in the transition lithology. Sandstones are not developed (Figure 1).

The feature of electrofacies: The amplitude value of curve is low, and amplitude separation is very little. Curve shape is smooth and flat, also can show tiny tooth-smooth shape, if there is a small amount of finger peak of medium-high amplitude value, the curve is irregular tooth shape.

2.2.2 Front delta subfacies

(1) The former delta mud microfacies

This is the main sedimentary microfacies of front delta subfacies, which primarily deposits dark gray and brown mudstone, developimg flat bedding (Figure 2).

The feature of electrofacies: Electric log presents low amplitude value, and the shape of SP curve is low-flat.

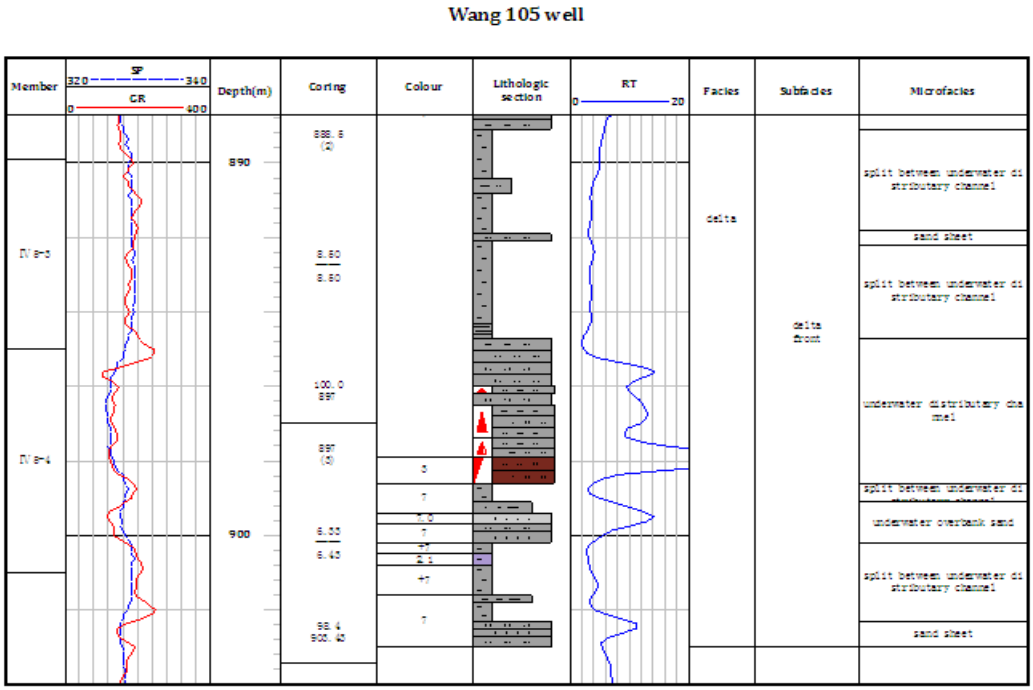

Fig.1 delta front subfacies model

(2) Turbidite sand microfacies

Turbidite sand is developed in underwater distributary channel, sand sheet in the front of mouth bar, and the former delta mud. The size is uneven, sorting is poorer. The main characteristics of the plane is elliptical with a thick central, surrounded gradually thin thickness. Lithology is mainly fine sandstone and siltstone, containing muddy siltstone, characterized by deformation bedding and Bouma sequence, the average single sand thickness is 1-3m (Figure 2).

The feature of electrofacies: The log shape presents low amplitude bell with medium amplitude separation, and the top is gradual contact.

III. THE FEATURE OF PLANE SEDIMENTARY MICROFACIES

The different periods of distributary channel advancing direction, and the size of the energy and duration constantly changes, result in large changes in sand on plane and different microfacies overlapping each other, appear alternately on machine direction[6]. On the basis of all wells sedimentary microfacies analysis, the plane sedimentary microfacies graphs of Ⅳ5 member of formation were draw.

The provenance of H3Ⅳ5 member is mainly Houzhuang braided stream delta in the east and Wangji delta in the west[7], initially Wangji delta has bigger impact than Houzhuang braided stream delta. The member mainly developed underwater distributary channel, mouth bar, underwater overbank sand, sand sheet, split between underwater distributary channel and lake. From H3Ⅳ5^5 member to H3Ⅳ5^1 member: the Wangji delta water from shallow to deep, from deep to shallow, especially the facies is entirely lake in H3Ⅳ5^3 member, individual well is developed turbidite sand. Underwater distributary channel development flakes in H3Ⅳ5^5 member, but disappears in H3Ⅳ5^3 member, H3Ⅳ5^2 member growths strip, H3Ⅳ5^1 member develops into sheet.

The influence of Houzhuang braided stream delta gradually become larger.

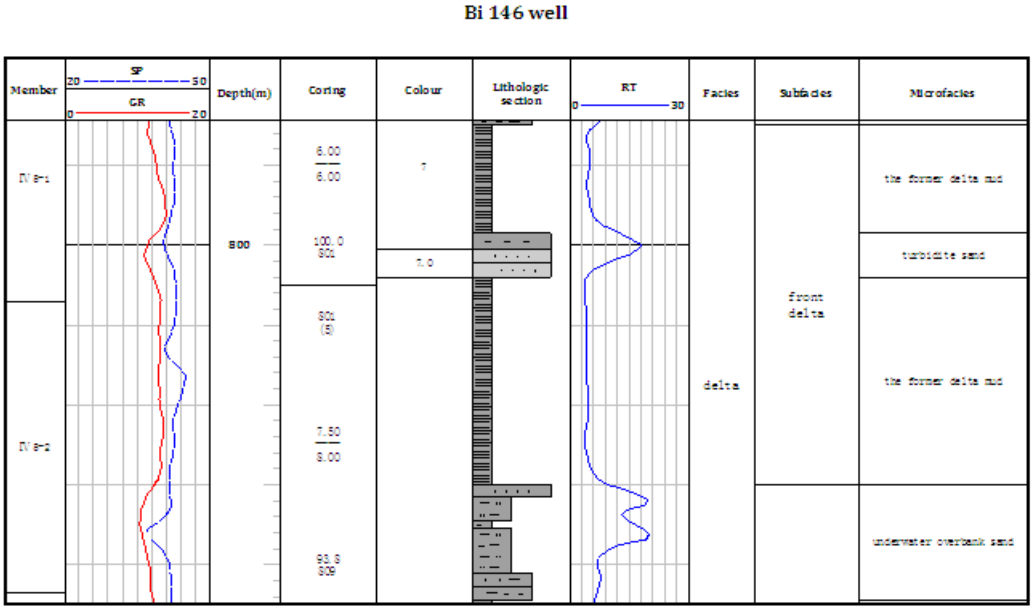

Fig.2 front delta subfacies model

IV. CONCLUSION

(1) Based on Phase analysis of single coring well, we determine that sedimentary system is delta including Wangji delta and Houzhuang braided stream delta, delta developed delta front and front delta subfacies, including seven types of microfacies which are underwater distributary channel, mouth bar, underwater overbank sand, sand sheet, split between underwater distributary channel, the former delta mud and turbidite sand.

(2) As a whole, Granularity of H3Ⅳ5 mermber is coarser in the west, and sand body widely distributed than the east. Wangji delta development is common, and the direction is northwest to southeast. The overall direction of Houzhuang braided stream delta is east-west, a small part is west-east direction.

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