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A study on the characteristics of reservoir in 1 and 3 fault blocks of Gangxi

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Abstract: For the purpose of studying the distribution and the rule of oil -water movement in 1 and 3 fault blocks of Gangxi fist area，we conduct a research on reservoir heterogeneity of the Guantao formation and the Minghuazhen formation in this area. Through comprehensive use of core and logging data, we analyze microscopic, layer,interlayer and plane heterogeneity of reservoir and the result shows that the main target reservoir heterogeneity is strong in 1 and3 blocks of Gangxi first area。The aeolotropism in this area is controlled by the deposition of the reservoir. We consider that the distribution of the reservoir is controlled by the distribution of the sedimentary microfiches.
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I. THE INTRODUCTION

Gangxi first area, about 40 kilometers southwest located in Tianjin Dagang district, is adjacent to the taping village, flat. Its geological structure is located in the middle of huanghua sunken, west of secondary buried hill structural belt in BeiDaGang. One, three fault block is located in the north-central of GangXi oil field, as the main oil-bearing fault blocks[1]。The main oil-bearing series are Minghuazhen Formation and Guantao Formation.

1、facies of the reservoir rock types

1.1Conglomerate facies

The distribution of conglomerate facies is less in the Minghuazhen Formation, conglomerate is mainly gompholite. Its color is gray red～gray yellow, the size of Gravel is disproportionate， the little one is As small as 2 mm，and the big one Can be more than 130 mm。Gravel has a certain grinding roundness。This sedimentary structure reflects sedimentary characteristics of high-energy, sudden and moving after a short distance。Gravel is about 1.5 m thick. Below is about 0.5 m of pebbled sandstone，Above is about 1.8 m conglomeratic sandstone and pebbled sandstone .The gravel are in boulder gompholite。The glutamate section is 3.8 m thick。

1.2 Sandstone facies

Sandstone facies is the most development of reservoir rocks。Packsand is the most common, only a few is medium sand。Single sand body thickness is between 2-5 m，The thickest compound sand body can be up to 15 m。Single sand body is commonly granular positive rhythm with below grit and above fine。Most of the sandstone is pure, and some sandstone contains argillaceous or calcium stripe。

1.3 Siltstone facies

The distribution of siltstone is relatively small。It appears in the following three types of occurrence：①At the top of sand body；②In the interior of compound sand body；③Separate distribution, Up and down of which are mudstone. Siltstone usually development hummocky cross-stratification。

II. RESERVOIR SEDIMENTARY MICROFACIES TYPES AND CHARACTERISTICS

Gangxi development zone Neocene belongs to the depression period sedimentary。Minghuazhen Formation belongs to curvature in meandering river sedimentary, whose characteristics are between typical meandering river and typical braided river[2]; Guantao Formation belongs to a typical braided river sedimentary。
2.1 Minghuazhen Formation Camber in meandering river reservoir microfacies types and characteristics

Reservoir microfacies types： main stem channel、point bar、branch channel,etc。

2.1.1 main stem channel：At the bottom it is detainment sedimentation or mainly massive sandstone sedimentary, in abrupt contact with underlying mudstone , Upward into other facies。Sand body thickness generally is more than 3.5 m,Electric logging curve is given priority to with bell-shaped or box [3]。Within the scope of research ,some dam characteristics in vertical are obvious, but not typical in the plane。

2.1.2 Branch channel fill sand body：It is a small river sedimentary filling, the sandstone is 2 ~ 5 m thick or so. Most is fine sandstone, with particle size of positive rhythm. The electric logging curve is refers to the type curve [3]。

2.2 The types and characteristics of Guantao Formation braided river reservoir microfacies

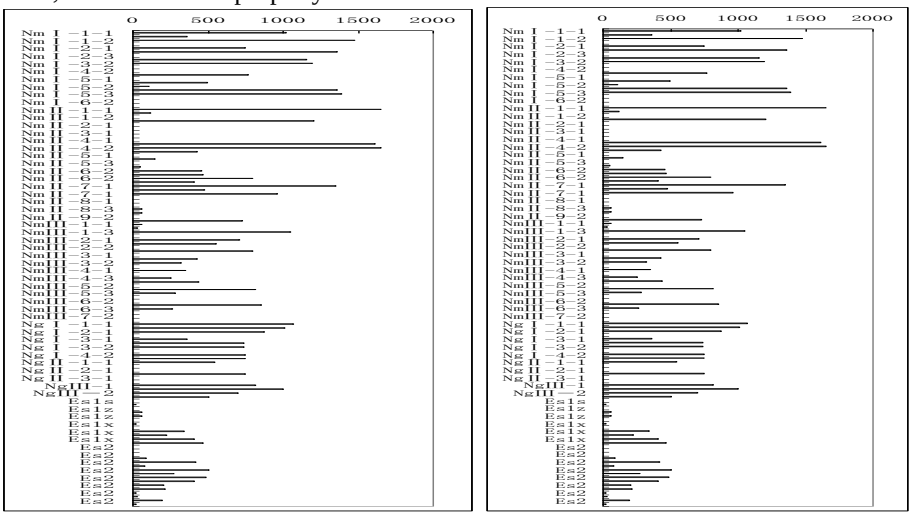
Reservoir microfacies types mainly are braided channel and channel bar,etc， in this district drilling well is less。

III. THE CHARACTERISTICS OF MICROSCOPIC STRUCTURE OF RESERVOIR

3.1 Basic characteristic of reservoir property parameters

According to the analysis data of neighboring block coring Wells petrophysical in the area. A small layer is as a unit;Minghuazhen Formation cement is given priority to with shale reservoir，pore cementation, compaction is poor， porosity between 3.06 ~ 46.8%，The average porosity is 31%；Permeability is between 0.6 ~ 16423×10^{-3}μm^2，Average permeability is 524×10^{-3}μm^2，Reservoir physical property is given priority to with high porosity and high permeability.Shale content at 12.56%，calcium content at 7.58%，The sand body on the plane takes the lenticular distribution, and the distribution range is small, with large difference thickness。

Vertical property：From top to bottom it has porosity, and the permeability decrease with increasing depth， For example, west 48-8-6 Wells (figure 1-1)。According statistics its property is mainly controlled by sedimentary facies, the main facies property are better than the none main.



Porosity Permeability

FIG. 1-1 West the 48-8-6 Wells vertical property

The main facies belt of Guantao Formation braided river sedimentary sand body is diara microfacies；under Minghuazhen Formation meandering river sedimentary sand body of main facies belt is the point bar microfacies。Statistics suggest that the point bar microfacies physical is properties to the diara.

3.2 Pore types

There are four basic pore types in sandstone reservoir: intergranular pore and dissolution pore, micro pore and fracture。Through the sample casting thin sections of 7 coring Wells, images, and scanning electron microscope ,we identify pore structure and its genetic mechanism ,and we classify reservoir pore。Pore in primary and secondary development at the same time, primary intergranular pore is the main pore, followed by secondary intergranular pores and solution pores in the granules。

3.3 Throat types

By using the microscopic identification, the authors can be found that there are four types: 1) throat pore narrow type 2) type necking throat 3) flake or curved flake throat 4) bundle throat. Reservoir and the reservoir seepage performance depends on what kind of plays a leading role to throat, and throat of reservoir in

this area is given priority to with type 1 and type 2.

3.4 Pore size and configuration

The results of image analysis show that the average pore diameter in this area is between 29.4 to 93.6μm, average pore diameter is 56.2μm, average throat diameter is between 4.59 to 13.9, the average throat radius is 8.77μm microns, the average pore diameter rate is 5.75, the average coordination number is 3.91.

Reservoir macroscopic heterogeneity characteristics

4.1 The types and distribution characteristics of permeability rhythm within Layer

Through a combination of core and well logging data, in the highest segment of permeability within a single sand layer and its change rule in vertical, to determine the type of single permeability sand body rhythm. Through the analysis of the key core hole, determine the type of rhythm.

4.1.1Positive rhythm：The highest permeability section of sand body at the bottom, smaller upward(figure 1-2)[4]。

4.1.2Type of compound positive rhythm: Highest permeability of sand body relatively homogeneous segments is at the bottom of each cyclic sedimentation (figure 1-3)。

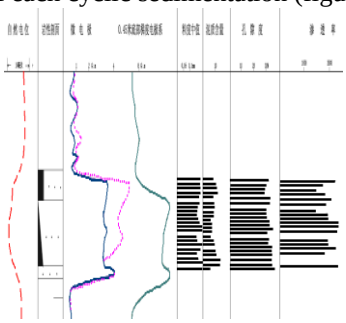


FIG.1-2 Permeability of positive rhythm type

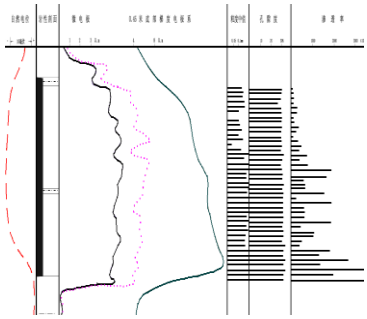


FIG.1-3 Permeability of composite type positive rhythm

Logging secondary interpretation results show that：Minghuazhen Formation is given priority to with positive rhythm type and compound type of positive rhythm [5]。It shows that the stuff within the layer property is controlled by sedimentary environment and sedimentary mode。Because Minghuazhen Formation belongs to the meandering river deposition, sand body is given priority to with point bar facies, so high permeability section is usually located in the bottom of each cyclic sedimentation.

4.2 Interlayer heterogeneity：According to the core data of lithology、granularity、physical properties, and combining with electric logging curve characteristics of reservoir interlayer heterogeneity characteristics research。

Table 1-1 reservoir heterogeneity between layers of parameter tablein 1 and 3 fault blocks of Gangxi

项 目		渗透率（$10^{-3}\mu m^2$）		砂体厚度（m）		变异系数（Vk）	突进系数（Sk）	级差（Nk）
层 位		区间值	平均值	区间	平均值	平均值	平均值	平均值
Nm下	Ⅰ	100.15-5000	1840.53			0.68	2.72	49.93
	Ⅱ	100.24-5000	1439.18	0.4-21.8	4.45	0.71	3.47	49.88
	Ⅲ	104.61-5000	942.24	0.5-24.4	4.83	0.87	5.31	47.8
平均值		100.15-5000	1562.87	0.4-24.4	4.78	0.75	3.2	49.93

Data analysis from the table 1-1，sand layer thickness of single sand bodies has a big change。Permeability heterogeneity evaluation parameters reflect sand body heterogeneity is stronger in the Minghuazhen Formation,the coefficient of variation is greater than 0.7。Nm Ⅱ, Nm Ⅲ oil group are the worst ,pounce coefficient is generally greater than 3。

4.3 Plane heterogeneity characteristics

4.3.1 Sand body geometry and connectivity features葛

In Minghuazhen Formation, according to the study of sedimentary microfacies and contrast between Wells, reservoirs are mainly point bar and channel sand body and other microfacies sandbodies build ability is limited。On the section many sand body is lenticular.Plane is a article belt extension. The thickness of single sand body is usually 3 to 7 m, the thicknest one can be up to 18.4 m.The width of the single sand body is

generally narrow, the vast majority of sand body lateral is hard to track more than two Wells . Because the strength of the issue of water is different, the sizes of reservoir sand body are also different.

About connecting ways, sand body in MingHuaZhen formation group is main "half-connected". Under the control of lateral migration in the river between sand body, the connecting form of sand body is given priority to with isolated and multilateral [6].With the influence of the fault, it formed a multiple sets of oil-water and gas system with a single sand body as a main oil unit.

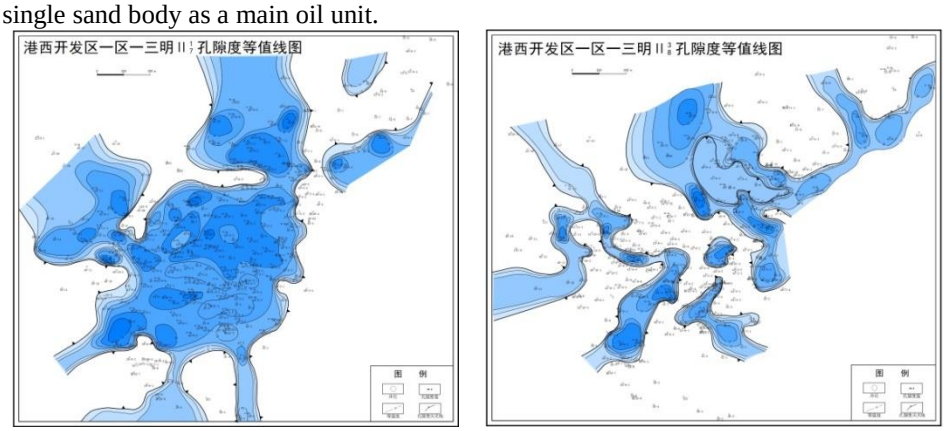


Figure 1-4 Area tourism Nm and Nm Ⅱ Ⅱ - 7-1-8-3 porosity contour map

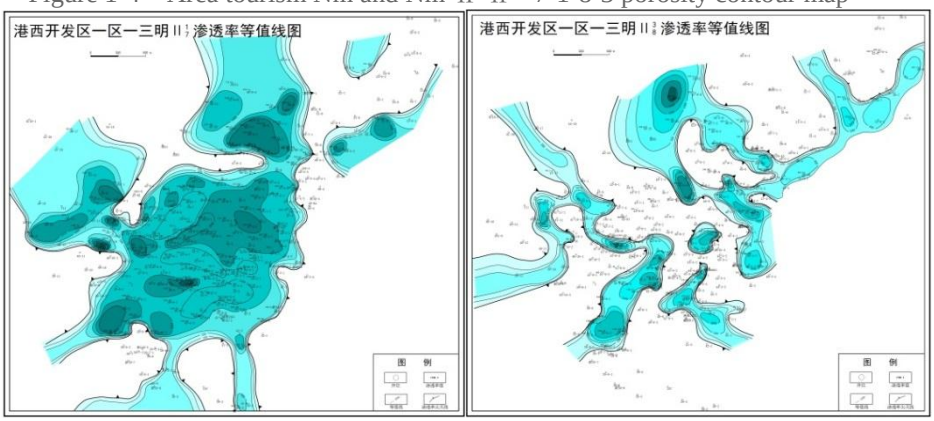


Figure 1-5 Area tourism Nm and Nm Ⅱ Ⅱ - 7-1-8-3 permeability contour map

4.3.2 The heterogeneity of distribution of reservoir permeability on the plane

Through the analysis of porosity of single sand body at each layer and permeability contour image，we found physical properties of the sand body on transverse are very different, and this is mainly controlled by sedimentary microfacies。Reservoir property is good on point bar deposits regional, porosity is more than 33% commonly, permeability is greater than 1200 x 10^{-3} μm^2, and formed high permeability zone like potatoes of subject, rather than the main generally reservoir physical property change poor。

4.3.3 Reservoir parameter distribution model on the plane

Because the different microfacies and different parts of the same microfacies have a very different reservoir quality, and this led to transverse difference whthin connecting sand bodies, and even cause seepage difference of fluid planar。

Figure 1-6 and 1-7 pictures show that the section of the river reservoir of Minghuazhen formation formed a narrow strip, wide strip and reticular high poroperm subject。For channel deposit，each river sedimentary reservoir parameters subject as the center,and evolutes regularly in both sides。The main sandstone has a big thickness, to become thinner on both sides. Subject porosity and permeability are both higher, to become lower on both sides. Heterogeneity is powerful within the center layer , to become more uniform on both sides. The center layer is single and branch to both sides.

Conclusion：

1）Work rock area of facies types including conglomerate, sandstone, siltstone and mudstone phase, and sandstone facies are composed of the main reservoir rock facies in this area。

2）Minghuazhen formation of camber is the meandering river deposition, main channel and branch channel are sand body development zone;Guantao formation is a typical braided river sedimentary, braided channel and beach are development zone of sand body。

3）Through study of reservoir microscopic structure characteristics, we analyze that the reservoir is the high hole and high permeability reservoirs.Its porosity and permeability decreased with increasing depth。

4）The reservoir in this area has a strong heterogeneity, and whthin the layer it is given priority to with positive rhythm type and compound type positive rhythm; Plane heterogeneity is controlled by sedimentary microfacies 。

5 ） Through the study we found that the reservoir development and be control by sedimentary microfacies.Therefore, the distribution area of favorable microfacies is a below exploration target。

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