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The reservoir characteristics research of the Qijia nan region in songliao basin

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Abstract: The Qijia nan region in songliao basin has substantial conventional and unconventional oil and gas resources. In this paper, the casting thin sections, permeability overburden pressure measurement and scanning electron microscopy (sem) and other experimental technology for integrated test evaluation of the reservoir in the region. Study shows that reservoir rocks in the region are lithic arkose and feldspathic lithic sandstone, maturity is relatively low; Clay minerals are mainly illite and chlorite and the slip layer, clay mineral content accounts for about 25% of the total. Sedimentary grains finer, more for silt, the median size is mainly distributed in between 0.1 ~ 0.15. According to the seismic facies and well logging data analysis research area exist delta and lake facies, delta front subfacies, front delta facies, shore and shallow lake subfacies and equal to four types of subfacies and semi deep lake. Widespread fossil ostracod, verified, ostracod fossils of diagenesis mainly tend to devastating effect. Poroperm towards density, average porosity is 11.6%, the average permeability of 0.46 x 10^{-3} μm^2, strong heterogeneity, and exist secondary porosity zone; Diagenesis is mainly for the dissolution and small amounts of carbonate cementation. Through all of the micro and macro information, using the characteristics of physical property and sedimentary facies sand body composite reservoir can be divided into Ⅰ, Ⅱa and Ⅱb, Ⅲ four kinds, provide reference basis for the exploration and development.

Keywords*: Qijia nan region; Ostracod; Dense oil reservoir; Reservoir characteristics*

I. THE INTRODUCTION

Dense oil is short for dense oil reservoir, it is by adsorption or free state occurrence in source rock, or with source rock layer, adjacent to the dense sandstone and dense carbonate reservoir rock, without large long distance migration of oil accumulation (Zou Caineng, etc., 2011201; 2 lj; Jia Chengzao, etc., 2012). According to different countries in different periods of oil resources and economic and technological conditions with different classification criteria. The porosity is usually less than 10%, permeability is less than 0.5 x 10-3 μm2 reservoir is defined as a dense sandstone reservoir. Compared with conventional natural gas reservoir, the tight sandstone gas reservoir with low porosity, low permeability, abnormal formation pressure, high capillary pressure and water relation and so on four big characteristics. In fact, the dense oil resources distribution is wide in China, the current in dense sandstone of ordos basin, northwest China, sichuan basin in Jurassic shell limestone and dense sandstone, Permian in junggar basin, silty dolomite and dolomitic powder sandstone, songliao basin Bai Kui spring head group of qingshankou formation of sandstone, has received some important discoveries, form the scale of reserves and the development of effective conditions (Zou Caineng, etc., 2011; lj; Jia Chengzao, etc., 2012).

In recent years, great progress has been made in dense oil exploration in the songliao basin and breakthrough, successively in daqing changyuan of fuyu oil layer, the high table in the reservoir, and other fields discovered huge resource potential of dense oil, submitted to the hundreds of millions of tons of proved reserves. Its regional high counter reservoir density oil exploration potential is bigger, resource evaluation results show

that it is (3 ~ 5) x 10 t resource potential, so it is necessary to strengthen the area of dense oil research, to provide guidance of dense oil exploration and exploitation in the study area.

II. THE GEOLOGICAL BACKGROUND

The Qijia nan region is located in the northern songliao basin in the central depression area own depression, north snakehead bubble sag, south to Hal temperature field, the main body of its south oblique and demodex west, sashi, apricot west three nose-like structure, to the west up to southeast tilt of monoclinic, lifting transition to east daqing changyuan, exploration area of about 1300 km2. Qingshankou formation sedimentary period of the larger lake invasion event happened, formed a large area of thick layer of deep lake facies dark mudstone folder shale; Its high organic matter abundance, organic types vary, qingshankou formation is a type I to type II1, qingshankou formation, two, three sections of type I to type II2, organic matter in the mature and high mature stage, the main hydrocarbon source rocks of basin (Gao Ruiqi and Cai Xiyuan, 1997; Hou Qijun, etc., 2009; Huo Qiuli etc, 2012). Superior qingshankou formation hydrocarbon source rocks of the conditions for its high counter reservoir density oil accumulation provides an important material basis.

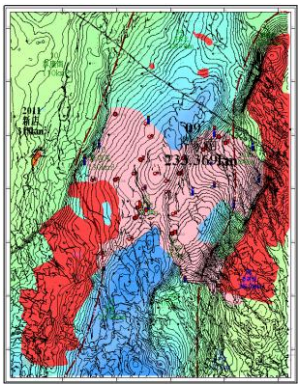


Figure 1 Location of the study area

III. SEDIMENTARY CHARACTERISTICS

The Qijia nan regional reservoir is given priority to with delta facies, sedimentary environment and northern terms south region was mainly affected by two north provenance, sedimentary types from north to south are mainly distributary channel and mouth bar, sandstone thickness distribution in the 30 m to 80 m, thickness of sedimentary body thickness is greater than the interchannel; South are mainly composed of sand sheet sedimentary to 21 G bubble south main development Ⅲ3-5 layer, and development in the region. The thickness of the 3 m to 6 m, suitable for horizontal well development. Found a large number of fossil ostracod longitudinal logo, to describe the core sand bed in common substances that contain calcium.

Ostracod can serve as a kind of symbol of sedimentary environment. The sedimentary environment mutation especially the cyclical downturn caused water becomes shallow lake plane, higher salinity and sandstone into shore and shallow lake, may be the direct cause of death in ostracod cluster sex. Ostracod layers are mainly distributed in lacustrine mudstone, top of the sand beach bar and sand sheet, in the delta front subaqueous distributary channel usually less development. Undeveloped ostracod layers of bedding, parallel bedding, cross bedding. Occasional Ostracod shell intact, more than double hull, single shell, has the characteristics of the typical buried in situ.

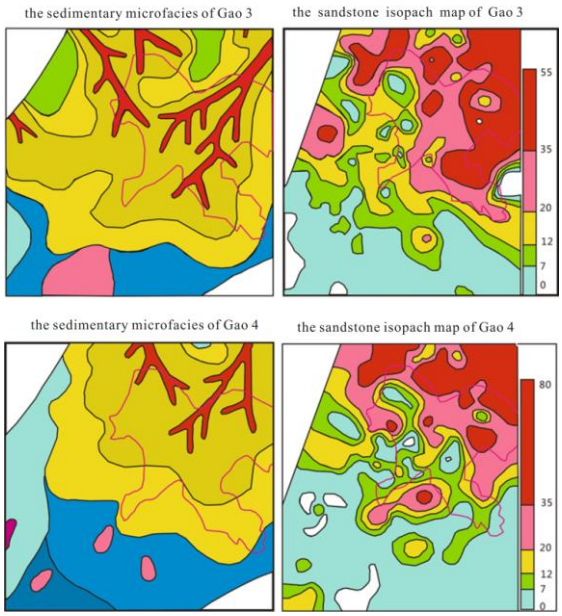


Figure 2 Qijia nan objective strata sedimentary sand body exhibition layout

Median size is mainly distributed in between 0.1 ~ 0.15 mm, sorting coefficient of average value is 2.77, and poor sorting.

IV. PETROLOGY CHARACTERISTICS

Through the core sample observation and microscopic rock thin section identification, found that research in high platform mainly feldspar lithic sandstone reservoir sandstone type. Core fine description (cm or mm scale) found that the development of thin sand of mudstone, increased the reservoir sand ratio and dense oil exploration potential. According to the target area of 53 Wells data, three, four types of rocks triangle.

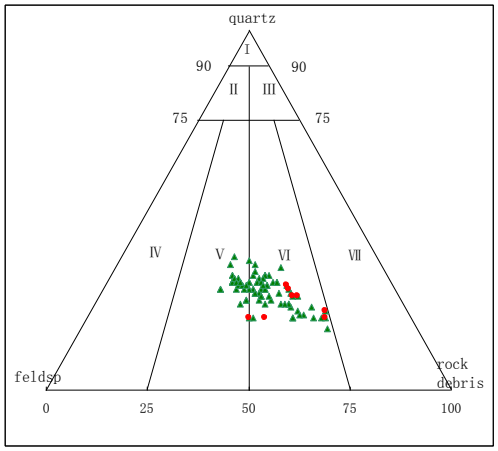


Figure 3 Rock classification figure

According to the typical Wells G933 fine found to describe the core research area reservoir lithology is mainly for the powder sandstone and argillaceous siltstone and silty mudstone, carbonate and argillaceous cement composition, and there are good mud shale. Quartz content on average 27.52%, feldspar content on average 27.57%, the content of cuttings on average 32.73%, argillaceous cement content on average 4.63%, carbonate content is on average 9.83%.

V. RESERVOIR CHARACTERISTICS

Through data analysis and research in core porosity and air permeability, shows that the porosity in the area of 2.9% ~ 16.8%, the average is 11.6%; Air permeability is 0.01 ~ 2 x 10^{-3} μm^2, with an average of 0.46 x 10^{-3} μm^2, permeability are mainly distributed in 1 x 10^{-3} μm^2. Therefore, the research in high platform three or four period of reservoir physical properties with low porosity low permeability reservoir characteristics, poroperm correlation is better.

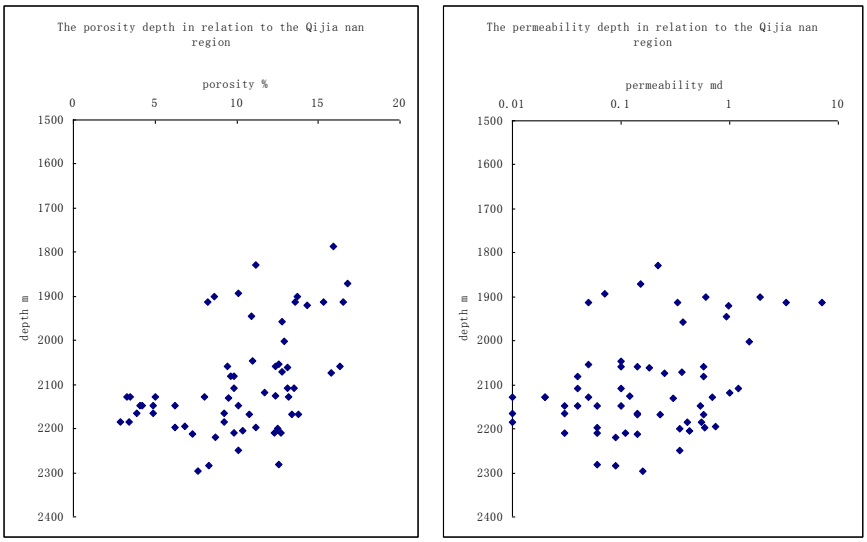
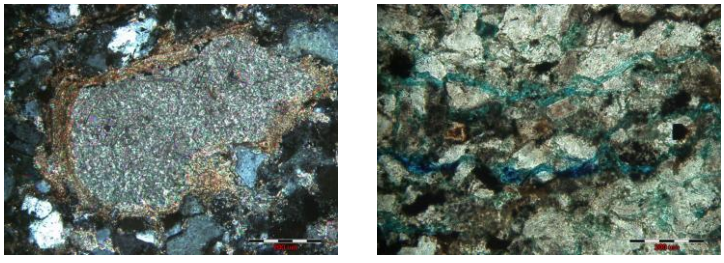


Figure 4 Hole infiltration depth diagram

According to the measured data statistics show that in the region of 2000 ~ 2200 m exist secondary porosity zone, pore zone mainly for secondary pore dissolution; 1 x 10^{-3} μm^2 permeability are mainly distributed.

Through the thin section of eight Wells, thirty casting thin sections, seven hundred and twenty-two photos of the observational study found: types of minerals are mainly quartz, feldspar, gypsum and calcite. Is a rare secondary increase; Chips generally contain ostracod fossils, but fossil ostracod stage time, does not play a decisive influence on the pore, some enrichment of ostracod pore development is extremely low; Ostracod pore is mainly for internal cavity around edges cavity corrosion and corrosion, a small amount of dissolution. Near calcium cementation; Pore development generally as the secondary pore, dissolution pore to play an active role; Compaction is relatively strong, particles as a linear contact generally, individual there is a bump contact relationship; Grain is fine, sorting is relatively good, roundness is low, lead to the microscopic are less selected are more typical, clear the dissolution of samples. Dissolution produce yarn mesh substrate; Cracks in the relative development, existing invalid fracture (fill argillaceous, calcium), cracks effectively. Individual found effective crack in mixed a large amount of argillaceous, namely the invalid existing relationships with effective cracks (period, etc.). At the same time, the development of fracture reflects the degree of brittle rock.



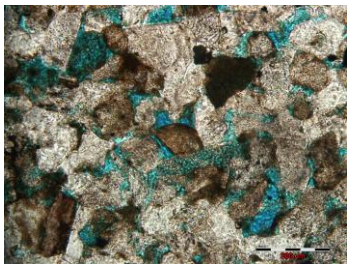



Figure 5 The reservoir pore characteristics of the Qijia nan region

Table 1 ostracod relationship with permeability test

Serial number	porosity %	permeability md	depth m	Porosity development degree	Ostracod content	Integrated interpretation
G1	10.66	0.12	2184.31	good	inexistence	poor reservoir
G2	6.48	0.03	2210.58	poor	enrichment	poor reservoir
G3	10.8	0.57	2205.36	good	inexistence	poor reservoir
G4	3.96	0.02	2222.37	poor	enrichment	dry layer
G5	9.11	0.02	2201.01	poor	exist	poor reservoir

Through the typical Well of the casting thin sections observation of G933 and related to log interpretation data found that the existence of ostracod for pore development did not play a positive role, with widespread fossils, caused the reservoir rich in calcium, fossil ostracod near with carbonate cementation, the porosity play a negative role.

VI. RESERVOIR COMPREHENSIVE EVALUATION

Based on the above research, combining macro sedimentary characteristics and microscopic physical characteristics to classify reservoir comprehensive evaluation, get Ⅰ, Ⅱa and Ⅱb, Ⅲ four types of the reservoir.

Ⅰ reservoir mainly underwater distributary channel, mouth bar and the main sand sheet around the sedimentary facies is given priority to, has good sedimentary conditions and sand body matching, is combined with thin thick sand, mud, porosity is greater than 15%, permeability is higher than 1 x 10^{-3} μm^2, reservoir space is given priority to with micro cracks and corrosion holes;

Ⅱ class a reservoir mainly debouch bar, sheet sand, such as around the inner to the outer of sedimentary facies, sand with sand mud interaction mechanism, between 12 ~ 15% porosity and permeability between 0.3 ~ 1 x 10^{-3} μm^2, reservoir space is given priority to with dissolution pore and fossils solution pores;

Ⅱ class b reservoir mainly sand sheet and around the outer edge of sedimentary facies, sand body structure belongs to clip a thin layer of sand mud type, between 5 ~ 12% porosity, permeability in between 0.06 ~ 0.3 x 10^{-3} μm^2, reservoir space in dissolution intergranular pore and intergranular pore authigenic mineral;

Ⅲ class reservoir mainly sand sheet flange for sedimentary type, sand body structure for the mud clamps silty

mudstone, porosity is lower than 5%, permeability is less than 0.06 x 10^{-3} μm^2, reservoir space is given priority to with microporous, mixed solution pores.

Table 2 reservoir comprehensive evaluation

Classification of parameter		Reservoir classification			
		Ⅰ	Ⅱa	Ⅱb	Ⅲ
Sedimentary characteristics	Sedimentary type	Underwater distributary channel, mouth bar, the main body around the sand sheet	Mouth bar, sheet sand. Around the inner to the outer	Sheet sand, sand sheet around the outer edge	Sand sheet flange
	Sand body structure	Thick sand, thin mud	Sand mud interaction	Mud clamps thin layer of sand	Clay silty mudstone
	Sand body thickness（m）	＞2	1.5~2	0.75~1.5	＜0.75
Physical characteristics	φ（%）	＞15	12~15	5~12	＜5
	K（mD）	＞1	0.3~1	0.06~0.3	＜0.06
Pore types	The main reservoir space types	Micro fracture, intergranular dissolved pore, intragranular dissolved pore	Intergranular dissolved pore, intragranular dissolved pore, biological fossil solution pores	Corrosion remaining intergranular pore and intergranular pore authigenic mineral	Microporous, mixed solution pores
Reservoir evaluation		good	Secondary preference	Moderate deviation	poor

VII. CONCLUSION

1, Qingshankou formation of high-quality hydrocarbon source rocks as the study area has ensured the oil and gas reservoir; Is given priority to with delta facies and sedimentary facies in the study area there exist certain littoral and shallow lake facies, reservoir sedimentary types from north to south are mainly distributary channel and mouth bar.

2, ostracod widespread, research area, but did not play a positive role to the reservoir; Relatively high brittleness of reservoir fracture development relatively, dissolution mainly positive effect on the pore development.

3, according to the corresponding characteristics of reservoir are divided into Ⅰ(good), Ⅱ(medium preference), Ⅱb (medium), Ⅲ(poor) four types of the reservoir.

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