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Geological Characteristics and Development Characteristics of the 45 Block in Daqing Oilfield

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Abstract: This paper introduces the geological features and the development of daqing oilfield, through the characteristics of reservoir classification and correlation and small layers evaluation, quantitative analysis of the reservoir lithology, physical property and heterogeneity, as well as the seepage characteristics and reservoir pore structure and reservoir sensitivity was evaluated, finally come to the conclusion.

Keywords: Geologic feature; Development characteristics ; Reservoir stratum ; Quantitative.

INTRODUCTION

The 45 block is located in Chaoyang gou of the axis of arch structure, side controlled by two big nearly fault, the overall trend from southeast to northwest tilt, northwest, southeast of oil-bearing area of 14.6km^2. The original formation pressure 8.43 MPa, saturation pressure 6.82 MPa, the average single well effective thickness of 9.6 m, and 1119.5 × 104t geological reserves [1]. Reservoir porosity by an average of 17.0%, the average permeability is19.2×10^{-3}μm^2, crude oil density of 0.8586～0.8866g/cm3 crude oil viscosity is 14.4 ～ 42.2mPa·s, wax content 15.5% ～ 29.8%, freezing point 25～43℃. Reservoir in the development of approximate horizontal subtle bedding, level seaming and nearly vertical tectonic seam. The blocks in fuyu reservoir mainly fluvial facies sedimentary.

Put into production in 1986, with 300m×300m by 1986 m nine point area of well spacing, injection-production system adjustment, in 1993 into linear water injection. Currently a total of 232 oil and water Wells, as of December 2013 is 1335×10^{4}m^3 water injection, accumulated oil production 402.4×10^{4}t , recovery degree 29.06%, comprehensive water cut by 58.20%.

GEOLOGICAL CHARACTERISTICS IN DAQING 45 BLOCK

Structure in Daqing 45 block

At 45 block is surrounded by north and south to fault, flush with the adjacent blocks apart, become a relatively independent complete horst, structure is relatively flat, in 100-68 Well for constructing high (at -650 m), to the south west, north, west, south wing Angle is 1.5 ° and 3 ° north wing Angle. Central reservoir depth of 980.0 m, single well mean effective thickness of 9.1m. Vertical reservoir structural fractures development, fracture density 0.13/ m, main fracture group system is in the north east 85 °, and injection Wells row direction.

Block in Fuyu oil layer of songliao basin is a large-scale settlement earlier formed a set of mainly fluvial facies sedimentation, sand body width generally between 300-800m, extended length of 2000-12500m. Because the rivers has strong ability of wash, cut, different size, different types of multiphase channel sand longitudinal cross superposed, flat cut, each single sand body is difficult to know.

Sedimentary units and sedimentary microfacies

According to the oilfield fluvial - delta reservoir sedimentary characteristics in "interface level analysis" and "facies controlled cycle" under the guidance of the principle, under the standard layer, standard layer control, cycle comparison of unequal thickness, a typical well sedimentary unit section and built whole oilfield skeleton closed section. On the basis of this, the block system layer is compared [2]. The Fuyu oil layer in the block is divided into 3 formation groups, 17 small layers and 41 sedimentary units.

Based on the principle of "facies corresponding", establishes a block of Fuyu oil layer in the unified logging facies model using the core data and rock electricity relation, divided into main channel sand, abandoned channel sand, distributary channel sand, crevasse channel sand, overflow shore sand (crevasse splay, natural levee, floodplain), split between mud, lacustrine facies sand sedimentary microfacies.

Sand body combination pattern classification

Microfacies combination, according to the rules, and deposited by a river, combined with the

sedimentary units of the sedimentary background and sedimentary characteristics, according to different types of reservoirs are drawn the sedimentary units of the facies maps identified shore shallow lake sand body and delta dendritic shunt channel sand body, low bending distributary channel sand body, Shun straight type diversion channel sand body and Limnology phase sand body for a total of five kinds of sedimentary type. According to the development of the sand body, it is divided into three types Ⅰ、Ⅱ、Ⅲ.

Class Ⅰ reservoir: including F Ⅰ 3_1 ,F Ⅰ 7_2, F Ⅱ 1 three sedimentary units, which belongs to the large low bending distributary channel, drilling ratio from 65.3% to 78.7%, single channel sand body width is 500～1000m, 2～6m thickness, width to thickness ratio is greater than 150, the composite meander belt complex shape and width more than 1500; electric curves to the bell, as shown in the box, the point bar lateral deposition of sediments, sedimentary characteristics of vertical auxiliary, meandering section of point bar lateral accretion, positive rhythm, thin layer of mudstone interlayer showed skewed distribution, the edge of the sand body and the top of poor property, lower the property is better, and the straight river section of vertical accretion, homogeneous block rhythm, good communication.

Class Ⅱ reservoirs: including F Ⅰ 3_2, F Ⅰ 6_2, F Ⅰ 7_1, F Ⅰ 2_2 total of four sedimentary units, which belongs to the small low bending distributary channel deposit, drilling ratio about 30.4%, single channel sand body width of 200～500m, the thickness of 1～5m, generous than 100～150, compound meander belt width 1000m. Sand body boundary smooth twists and turns, the convex concave interphase on both sides of the corresponding coordinate; the edge of the river development a small amount of Hejian overbank deposition, in the edge of the concave bank have small abandoned channel deposition, see less internal; electric logging curves based on bell.

Class Ⅲ oil layer: including 34 sedimentary units, three types of sedimentary. A (III) is straight distributary channel deposits, to F Ⅰ 6_1, F Ⅱ 2_1—F Ⅱ 5_3 is typical, the sand body is narrow banded, the combination of form and different, not obvious difference between normal and abandoned channel deposition, thickness 1～4m width of 100～300m, and the section is in top flat convex or biconvex lens; ⅢB is delta branched distributary channel deposit, only F Ⅰ 2_1 unit, the sand body width is very narrow, mesh - dendritic branching; ⅢC is shore shallow lake and lake facies, sand body distribution of scattered, the area is generally 1-3 Wells.

Analysis of rock and fluid properties in closed core wells

According to the obtained from sealed gasometry for core well towards the 104-58 core, the average air permeability $22.5\times10^{-3}\mu m^2$, 17.0% effective porosity, permeability relatively higher layer mainly distribution in FI3、FI6、FII1, plane and interlayer permeability difference is bigger, the heterogeneity of serious. Layer plane of permeability in 7.6-67.1, interlayer permeability onrush coefficient in 1.85-3.96, coefficient of variation in 0.52-1.3, average for 0.8275.

Table 1: Daqing in 45 block reservoir lithology data tables

Reservoir	Median size (mm)	Detrital composition			Porosity (%)	Ermeability ($10^{-3}\mu m^2$)	The original oil saturation (%)
		Quartz (%)	Feldspar (%)	Rock debris (%)			
Mud fine sandy siltstone	0.066～0.115	26.3	27.6	32.7	17	19.2	59

Table 2: Statistical table of ground crude oil properties in the 45 block of Daqing

Viscosity (mPa.s)	Density (t/m^3)	Wax (%)	Glue (%)	Freezing point (℃)
18	0.861	22	16.2	31.7

Table 3: High pressure physical property analysis data sheet of the 45 block in Daqing

Formation crude oil density (t/m^3)	Formation crude oil viscosity (mPa.s)	Original formation pressure (MPa)	Saturated pressure (MPa)	Gas oil ratio (m^3/t)	Volume coefficient	Compress coefficient (10^{-4}/MPa)	Dissolution coefficient
0.82	10.4	8.4	6.8	22.96	1.08	8.22	0.2906

DEVELOPMENT CHARACTERISTICS OF THE 45 BLOCK IN DAQING

The development process of the 45 block in Daqing

Block put into development in August 1986, starts the effect after water injection in April 1987, from 1993 to 1997 by the nine area well pattern into linear injection pattern, has obtained the good effect, oil production rate above 1.3% and stable yield for 10 years [3]. Since 1998, the block water began to raise, the production decline rate increase, to continuously strengthen comprehensive adjustment, after 2002, water cut rose to more than 50% and maintain a stable stage, block into the relatively stable stage of development.

Oil and water Wells is a total of 209 to December 2010 blocks, including 131 oil Wells, well open 117, average daily fluid 390t, nissan 164t oil, composite water cut 58.0%, oil recovery rate 0.5%, recovery degree 24.75%; 78 Wells, well open 74, average daily water injection 1252m^3. As of December 2013 is 1335×$10^4$$m^3$ water injection, accumulated oil production 402.4×10^4t, recovery degree 29.06%, comprehensive water cut by 58.20%.

Daqing in 45 block development characteristics

(1) Injection water absorption differences between the layers

At 45 block the water absorption ability is stronger, the well water absorbing capacity increased since 2005, but the main layer and the main water absorbing capacity difference increase, especially during 2009-2010, main layer absorbing water thickness ratio from 74.8% to 79.7%, rather than the main layer water absorbing capacity by 45.9% to 40.3%, two types of reservoir water gap widens, use condition variation between the layers [4].

(2) Composite water cut is higher, used varied at different positions of the block

Block composite water cut 58.0%, currently in Chaoyang higher level trench oil field. Water cut is more than 80% of the oil well number 23, water cut in 40-80% of the well number 47, and two together accounted for 59.8%. High containing water Wells are mainly concentrated in the central block, north to 45 block wing composite water cut is low, lower productivity.

(3) Damage Wells ratio is high, the injection wells casing damage effect layered water injection effect

45 block has found so far, the casing damage Wells 74, accounting for 35.27% of the production to the total number of Wells, which the oil well casing damage 35, 26.15% of the well; Water well casing damage 39, accounting for 50.65% of the total number of Wells. Deformation of casing damage Wells are affecting production and increase production of oil Wells, augmented injection, stratification, the implementation of thin layered work.

(4) Multiple fracturing wells ratio is high, the measures to reduce potential

For normal production of oil Wells are classified statistics show that the 45 block oil Wells has been fracturing well number 27 three times or more, 23.5% of statistical well number; Comprehensive 30 Wells of high water cut, accounting for 26.1% of the statistical number of Wells, comprehensive water cut has reached to 78.2%; The rest of the last three years have fracturing, water injection conditions, small thickness, bailing Wells total 35 mouth; Currently 23 mouth to fracturing potential well, but there are also problems such as high water cut, work over casing deformation.

CONCLUSIONS

Using the 45 block a large amount of actual production data, combined with the block of oil reservoir engineering method to address research deeply on the features and development, technical guidance, using numerical simulation model to the conclusion.

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