

Study on Oil-water Distribution Law in N74 Oil Field, Liaohe Basin

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Abstract :

The Xinglongtai reservoir has complex oil-water distribution in N74 oil field, Liaohe basin. For the analysis of the oil-water distribution and main control factors of the reservoir, we did some research on the oil-water distribution in horizontal and vertical directions, through the analysis of oil production test data, means of production and static conditions. In sedimentary cycles based on synthetic seismograms for the bridge, flag layer is controlled based on morphological characteristics of each hole logs, thickness, depth stratigraphic correlation, linking well with the cross section through the stratigraphic correlation method well seismic profiles unity. In this stratigraphic correlation, the full account of the delta sedimentary cyclicity in the vertical, lateral continuity sand characteristics poor, also taking into account lithological, stratigraphic thickness variation continuity analysis and distribution of water and gas distribution main factors. The results of the study will provide favorable geological basis for exploration and development in the future.

Keywords - Liaohe Basin, Oil-water distribution, distribution law; controlling factors

I. INTRODUCTION

Oil—Water distribution and the main factor is the focus of study in the field of oil exploration and development. People use geological sand body distribution, tectonic evolution, seismic inversion and reservoir anatomical methods of water distribution law of different angles and levels of study[1-2]. N74 construction - Central Green tectonic belt, oil-bearing area 2.63km², 4.9125 million tons of oil reserves (2005), calibrated recovery of 7.0%, recoverable reserves 34.4×10⁴t, the main oil line to Es2 segment, reservoir depth of 2950~3500.0m, block the use of 235m square well spacing well pattern into a layer system was developed in 2005, the same year in August into the water flooding. N74 production from cattle production so far has been in high water cut stage, the development process has taken appropriate adjustment measure, the development of effect has been some improvement. Since oil and water distribution and main factors of uncertainty has been evident in the water

flooding low degree of control, one-way communication with a large proportion of other issues, including wells and high inefficient wells gradually increased, seriously affected the normal oilfield development effect[3-4]. Through anatomy and reservoir water distribution analysis, clearly the main factor of reservoir water distribution, to provide guidance for future oilfield development. 1. Regional geology

N74 is located in the city of Liaoning Province, Liaoning Province, relatively flat terrain, agricultural development, mostly dry. The area belongs to the north temperate zone, semi-humid, semi-arid monsoon climate. Highway traffic is convenient, 30 Km away from Shenyang, 60 Km away from Liaoyang City distance. In the eastern sag of Liaohe northern region Niuju Central qinglongtai tectonic zone, north Niuju oilfield, south Dragon oilfield, west Ciyutuo field adjacent protrusions connected East and Eastern constructed on an area of the block structure 15km² (Figure 1), the main purpose of the oil sand layer Es₂, Es₃[5-6].

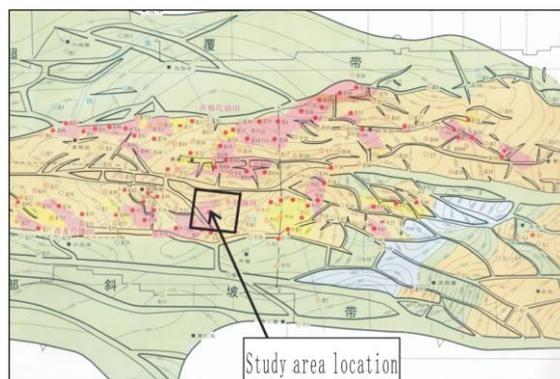


Figure 1 Study Area Location

Object layer of the present study was Es₂ corresponding to Xinglongtai reservoir. Es₂ bottom is filled with coarse sand deposited product, restricted distribution, with thick layer of fine gray sand, gray argillaceous siltstone, silty mudstone, clip gray, purple mudstone. Work area Es₂ thickness of about 310m,

stable sedimentary, stratigraphic parallel contact, unconformity and erosion were not found. Formation slightly thickened gradually from southwest to north east direction, the lower than the upper part of the formation strata slow, the overall wedge-shaped.

II. OIL—WATER DISTRIBUTION LAW

A. Oil—water flat distribution

Using oil test, production performance data, draw the study area Xinglongtai reservoir oil—water distribution diagram (Figure 2). Figure 2 shows: the northern oil higher, than the south of the northern oil-poor, the middle of the worst situation with low oil, during the transition zone connected by water.

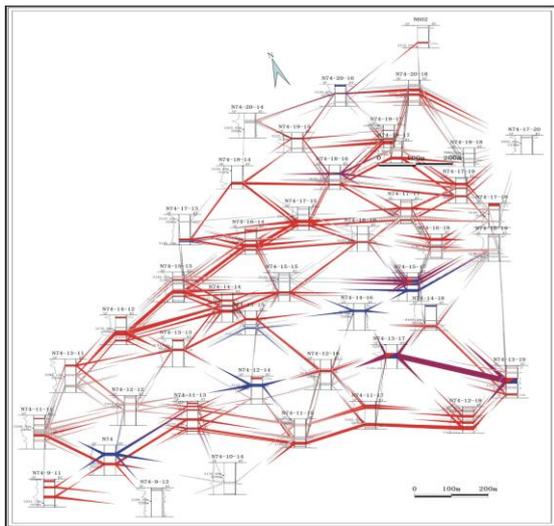


Figure 2 Oil—water distribution pattern diagram

Oil—water distribution have zoning characteristics in the plane. Due to the different elements in different parts of the accumulation, so from the water-rich south of the northern extent and enrichment law is different. According to the degree of enrichment of water, the N74 oilfield in eastern region is divided into three zones: the northern zone of pure oil, oil-water transition zone, the southern oil-rich zone, between the districts with the distribution of oil and water do not affect each other. According to the degree of enrichment of water, the N74 oilfield in eastern region is divided into three zones: the northern zone of pure oil, oil-water transition zone, the southern oil-rich zone, between the districts with the distribution of oil and water do not affect each other. Southern test oil well production capacity, mainly pure oil wells; the southern oil-rich zone, oil-water interface is more unified, single well water distribution mode mainly for oil or oil in water type with water type, but under

control of the oil-water interface has different anticline difference; due to the low potential properties, single-well water distribution pattern central region containing the lower portion of all water layer; the fault development is complex and subject to the impact of sand body distribution, oil and water relationship connecting the north and south and central regions with low potential is more complicated.

III. CONTROLLING FACTORS

A. Sedimentary Characteristics

According logging micro facies model and each hole logs of N74 Es2 sand layer by layer after logging facies identification, preparation of micro phase diagram region's small plane layer. N74 Es2 mainly developed fan delta front, specific sedimentary micro facies are: distributary channel, distributary channel, floodplain swamp micro facies, frontal sheet sand micro equal. Provenance direction from the north, to north east direction, is mainly distributary channel the NE-SW trending, instream mainly developed gray pebbly sandstone, fine sandstone. River in the degree of development of each period varies. Underwater channel micro facies were mainly developed from VII-3, and upward gradually shrinking river, narrowing the number of branch river has gradually increased, to the IV layer, then the underwater distributary channel deposit large area development. In the subsequent deposition period, the river has gradually developed, dominated, indicating the water is gradually shallow, sand deposition advance to the I layer deposition period, river sands development(Figure 4).

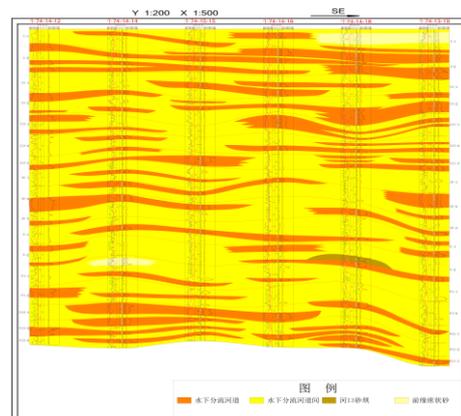


Figure 4 Sedimentary Facies Profile Map

Throughout N74 Es2 of the small layer of sand sands development, the sedimentary micro facies characteristics, it can be seen through the study area Es2 from shallow to deep water, then by the shallow depth of evolution, sand body is showing development -

no development - development of deposition phenomenon.

Physical property data has 42 well 592 data show that Es2 micro facies relative to reservoir properties has significant control effect. Underwater distributary channel sand bodies to the front fan delta reservoir porosity and permeability decreased. Underwater distributary channel microfacies has high porosity and permeability were 8.01%, 8.08mD, mouth bar somewhat less porosity and permeability, respectively, 7.73%, 3.29mD, while underwater distributary channel, before porosity edge sand sheet are less than 7% penetration rate was significantly lower, respectively 7.87mD, 3.61mD, is a low porosity and low permeability.

Sedimentary facies not only the physical properties of the reservoir has significant control effect, but also have some impact on the oil and gas reservoirs. 222 groups testing data of 24 wells show that oil in underwater distributary channel, frontal sheet sand, underwater distributary channel, mouth bar and the proportion was 86.1%, 6.5 %, 6.1%, 1.3%. Most of the distribution of oil underwater distributary channel micro facies.

B. Structural Features

N74 Oilfield is located in the northern part of Liaohe basin eastern depression, the evolution of tectonic faults subject to the development and evolution of Liaohe eastern depression. Faulting is the most basic features of rift basin, breaking the overall performance characteristics of the area the number of faults, large-scale, multi-phase development, group development, to tensional normal fault-based, local and having a reverse strike-slip characteristics. Structural map shows the study area mainly developed to NE-NNE, NEE-EW and NS to three faults, packet faults partitions have significantly different characteristics (Figure 5). They are mutual transfer or branch complex in space, development or inherit each other in time. Wherein the recess NEE-EW to show the main fault control basic framework and the depression secondary tectonic units of cloth and sedimentary filling process; NE-NNE and NS faults belong derived secondary level breaks, the secondary structure of the internal control unit off block and trap formation and evolution.

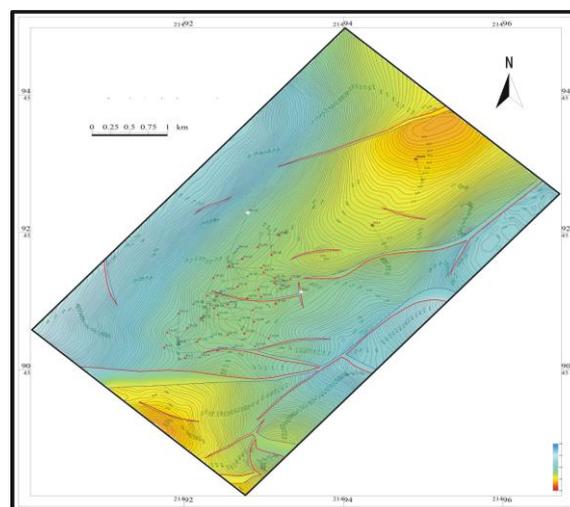


Figure 5 Xinglongtai reservoir top boundary structure map

On the plane, the work area to the south of the fracture and fracture of eastern boundary fault, its direction from the EW Switch NEE; a cross-section, with anticlinal ridge line as the boundary is divided into two areas. In the West Wing anticline, many faults appear as drop feature to the northwest; in the east wing of anticline, fault strike from EW Switch NNE. East Wing West Wing anticline formation compared to the formation slow. The southern boundary fault to control depression fracture controlled the sedimentary strata of the target interval (Es2). Eastern boundary fault is strike-slip faults in the work area showing tensile characteristics. In the center of the study area, due to the regional stress field formation rose arch uplift, anticline formed for hydrocarbon enrichment provides a good place.

IV. CONCLUSION

Oil was mainly located in high construction site. Sedimentary facies and sand body distribution control of the thickness of the oil layer. Oil—water distribution law was controlled by the oil source. Reservoir types are: faulted anticline, poured on lithologic reservoir tip off, the lens lithologic reservoir sandstone reservoir and other types of faults. profile.

REFERENCES

Examples follow:

Journal Papers:

- [1] YAN Ming, LI Yilin, &WANG Yumeng.(2014)Oil—water distribution law and controlling factors of Putaohua reservoir in the east of Pubei oil field. *Journal of Northeast Petroleum University*,38(6):54-60.
- [2] LIU Zongbao, YAN Li,YU Jing,&LIU Yunyan.(2012)Oil distribution rule and main controlling factors of Putaohua reservoir in Taidong slope ,Songliao basin. *Journal of Northeast Petroleum University*,36(6):14-21.
- [3] Kui Heming, Dang Ben, &Dun Tiejun.(2001) Characteristics of Insulating Layers and Evaluation of Sealing Ability from Xinglongtai Oil horizon of Liaohe Oil Field. *Oil&Gas Geology*,22(1):88-92.
- [4] WANG Lijun, CHEN Xinjun.(2003)Influence of Reservoir Heterogeneity on the Distribution of Remaining Oil. *Geological Science and Technology Information*22(2):71-73.
- [5] DUAN Yongxu.(2008)Analysis of Hydrocarbon Accumulation Conditions in N74 Oil Field, Liaohe Basin. *West-China Exploration Engineering*,9:65-66.
- [6] FENG Yuan,LIU Guangdi, YANG Weiwei, &GONG Yaojin.(2014) Characteristics and Models of Hydrocarbon Accumulation in Xinglongtai Oil Field, Liaohe Depression. *Marine Geology&Quaternary Geology*,34(1)137-141.