IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
Vol. 06, Issue 03 (March. 2016), ||V3|| PP 30-35

Research on main controlling factors of oil and water distribution in Wuerxun Depression, Hailaer Basin

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Abstract: After years of exploration, proved reserves of oil and gas increases constantly in Hailaer basin, The oil yield realizes the oil and gas production stably. Due to the complex basin structure and understanding of the sand body distribution , types and distribution of oil and gas reservoirs can't been known clearly. Especially Wuerxun eastern slope region showed complicated oil-water relationship. The control factors of the research has always been a difficulty in exploration and development. We should have a deep insight into oil and water distribution and controlling factors to guide the next exploration.

Keywords: *- fault analysis, fault slope belt, lateral sealing, oil-water distribution, Wuerxun depression*

I. INTRODUCTION

Hailaer basin is one of the biggest in Songliao peripheral basin oil and gas basin, located in Inner Mongolia Hulun buir Union territory. It is a multiphase composite and multiphase transformation fault depression basin type in the Cenozoic. Wuerxun sag is located in the middle of Hailaer basin[1]. Wu east slope belt is located in new barr tiger left flag of Hulun buir city in the Inner Mongolia autonomous region.
Total area of south exploration of Wuerxun is 1300km^2. The area of Effective source rocks is 445km^2. The average thickness is 365m. By reviewing three times and researching ,we think south belt has the resources.

II. HYDROCARBON SOURCE ROCKS

The main source rocks formation of Wuerxun sag in Hailaer basin is Nantun group(Fig.1). Damoguaihe group and Tong group also have source rocks. Nantun group is the best source rocks in basin[2]. The quality of Nan first group hydrocarbon source rocks is best.①Thin layer thickness is bigger.② High content of organic matter(TOC>5%), good type(type Ⅰ is priority, the mount of type Ⅱ$_1$ is small) ,hydrocarbon generation potential is high(S_1+S_2>20mg/g), most of the Organic matter is in phase of evolution(R_o>0.7%).
The dark mudstone of Nan first member contributes to the oil and gas resources of east slope of Wuerxun. The results of correlation between oil and source also showed that OEP of crude oil of Nan first member is close to that of dark mudstone（Table 1）. Pr/nC17 and Ph/nC18 of crude oil in Nan first group are also similar with that of dark mudstone of Nan first member. These all reacted that dark mudstone in Nan first member provides oil for the reservoir of Nan first member.

Table1 Statistics of OEP of oil and shale

Sample	N1oil	N2oil sand	D2mud	D1mud	N2mud	N1mud
OEP	0.998(5) / 0.93～1.05	1.045(23) / 0.95～1.10	1.412(20) / 0.74～2.97	1.162(7) / 1.02～1.35	1.137(39) / 1.02～1.27	1.098(47) / 1.01～1.64

Note： average (numberofsample) / min ～ max

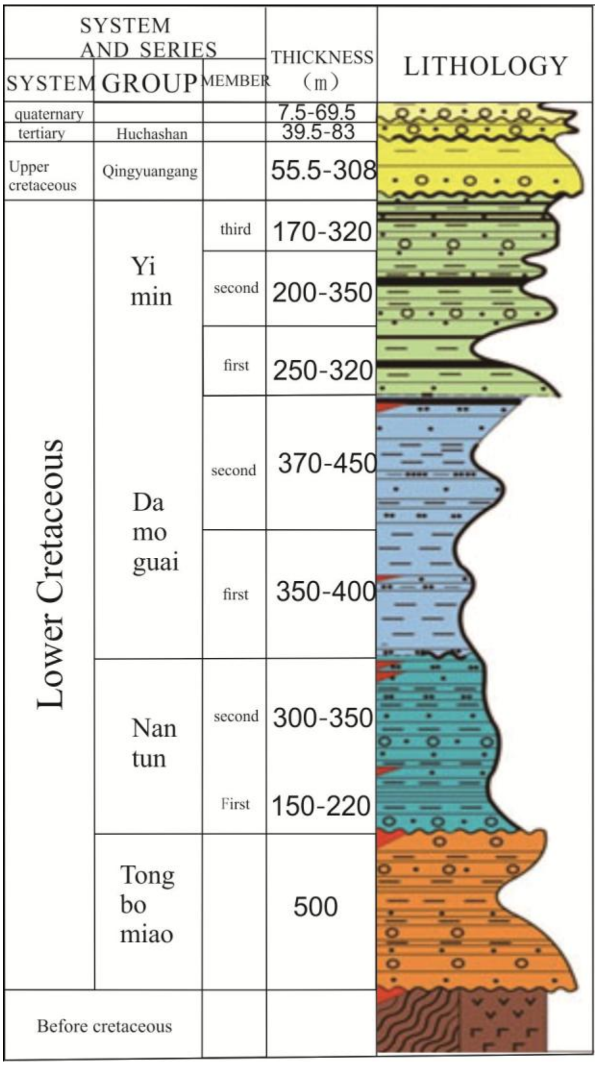


Fig 1 comprehensive stratigraphic column

III. SEDIMENTARY FACIES AND SAND BODY

Sand bodies of underwater distributary channels are developed in the braided river delta front in the eastern slope zone. And they become thinner to subsags. The number of formation is fewer. At the same time, sand bodies of river mouth bars in the end of the distributary channel are developing gradually. Crosscutting source section shows that sand bodies developed in the north and south of the study area. Lateral continuity of the channel sand body is poor, and the sand body of river mouth bar oval shape distribution.

Sedimentary facies and sand body distribution control the abundance of oil. All isolation of lenticular sand body can be industrial oil Wells. But to the continuous sand body, most of the walls,which are at the end of the braided river delta front distributary channel microfacies , are low yield oil wells. And the walls which are at the middle of distributary channel are industry walls with high yield.

IV. THE PARTICULARITY OF STRUCTURE DETERMINES THE ENRICHMENT OF OIL AND WATER

The development of the Nantun group and the Damoguanhe group mudstone is the main source rocks in this area. From subsags to fracture slope break then to the gentle slope belt, the relationship is water-oil-water. The eastern border of oil reservoir is controlled by nearly ns-trending fault. Nan first member formation which is at the east of the fault contains water. But from subsags to fracture slope break, the yield of oil walls is obviously more.

V. THE LATERAL SEALING ABILITY OF FAULT

A large number of fault traps are developed at the east slope zone of Wuerxun. Controled trap fracture of lateral seal ability determines the trap range and oil-water distribution relationship. For trap risk assessment to study the lateral sealing ability of fault has extremely important significance[3].

5.1 Lateral seal type of the controled trap fault at the east slope belt of Wuerxun

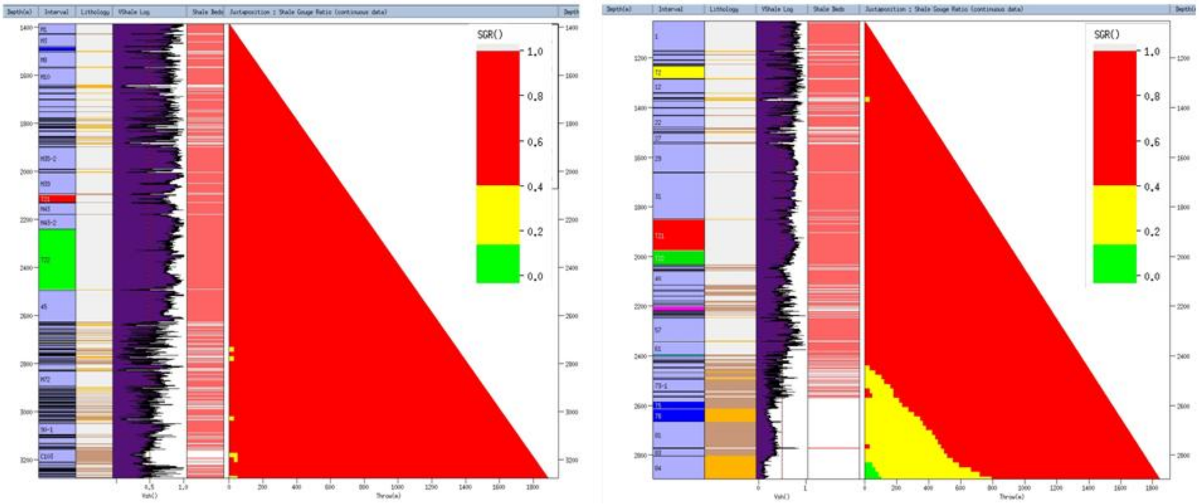
Wuerxun eastern slope belt widely exists sedimentary sequence of sand and mudstone layers. And fracture scale is large. Through mapping the section Allen of the joint of faults and lithology, it can be seen that cross section of sand is an area of the development of sandstone[4]. Lateral seal type of fault is given priority to fault rock closing.

Robert researched and suggested that fault mud ratio is a key factor in controlling fault rock type. When SGR<14%, Cataclastic rocks are mainly developed inside the fault zone. When 14%<SGR<40%, layered or framework silicate rocks exists in the fault rock. When SGR>40%, mudstone smear is main. There are two walls displayed by Knipe(Fig.2). Objective strata SGR value is greater than 14%. Main types of fault rock in the study area are layered, framework silicate and mudstone smear.

Fig 2 Diagram Knipe of Two walls

5.2The determination of the lower limit of lateral sealing ability of fault in the study area

We choose two traps(lasi-7 and lasi-26) which had been drilled to determinate the lower limit of sealing ability of fault.



5.2.1The determination of the lower limit of lasi-7(Table 2)

Table 2 trap lasi-7 elements

Name	Geological strata	The fracture of controlling traps	The top of trap	The depth of the Point of structure/m	Trap amplitude/m	The actual oil-water interface/m
Lasi-7	T23	TB78	-1750	-2175	425	-1905

Through simulation calculation, we took different lower limits respectively to get hydrocarbon column height of trapped, which is controlled by fracture(Fig.3). Then we converted it to the corresponding oil-water interface. Contrasting calculated oil-water interface and the actual oil-water interface, we selected value which is in conformity with the actual oil-water interface as the critical value.

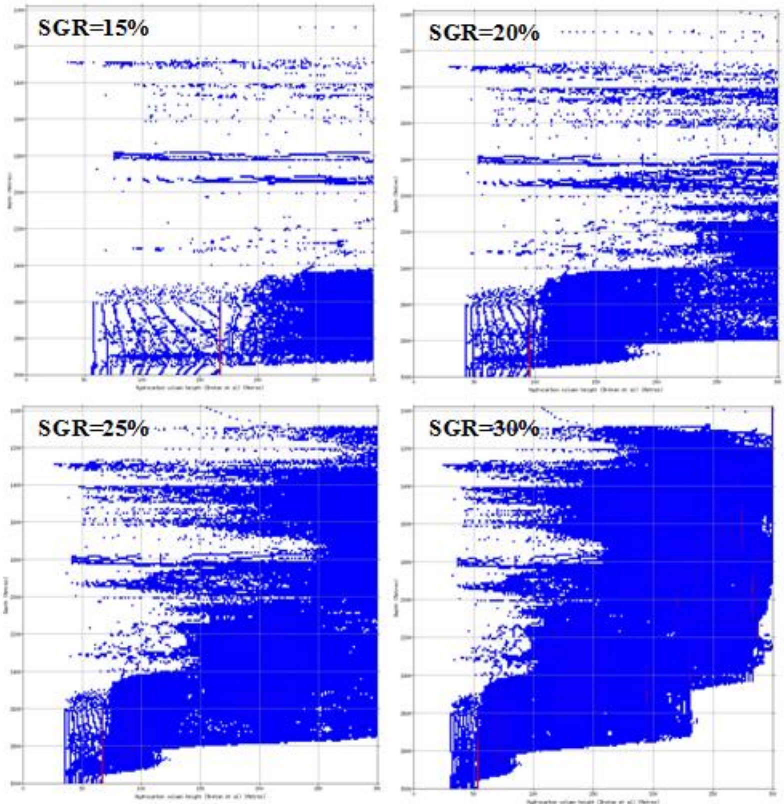


Fig 3 The hydrocarbon column height supported by different SGR lower limits of Lasi-7

By contrasting, considering the error factors, when the critical value is 25%, calculated oil-water and the actual interface is similar. So we use 25% as appropriate the lower limit.

5.2.2 The determination of the lower limit of lasi-26(Table 3)

Table 3 trap lasi-26 elements

Name	Geological strata	The fracture of controlling traps	The top of trap	The depth of the Point of structure/m	Trap amplitude/m	The actual oil-water interface/m
Lasi-26	T23	TB78	-1850	-2050	200	-1975

By doing the same research,we know that when the critical value is 25%, calculated oil-water and the actual interface is similar. So we also use 25% as appropriate the lower limit (Fig.4).

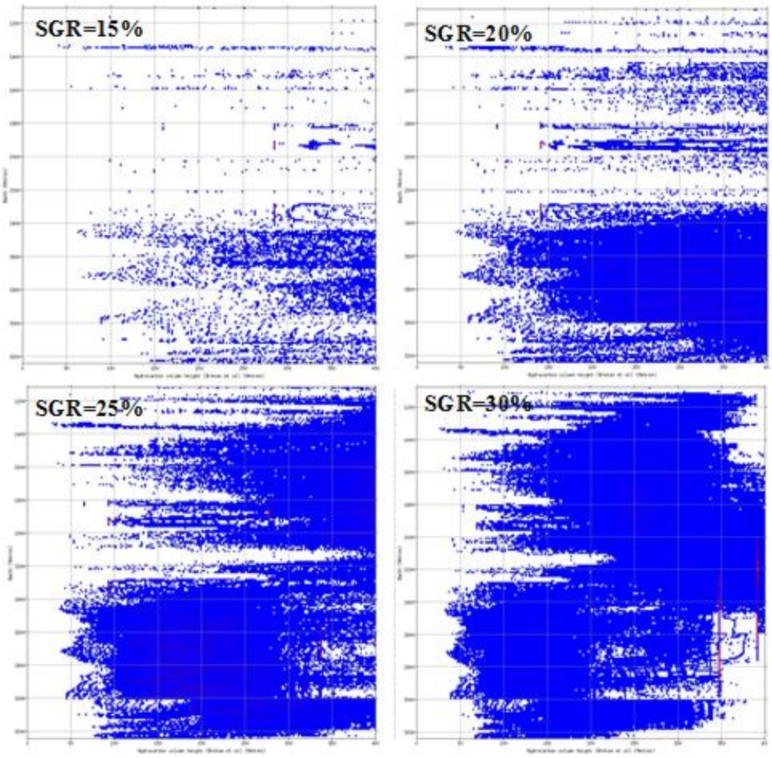


Fig 4 The hydrocarbon column height supported by different SGR lower limits of Lasi-26

5.3Lateral sealing ability characteristics of fault slope belt and its relationship with oil-water

Using graphic combined with fault slip, we analyzed lateral sealing ability of Nantun group fault in Wuerxun eastern qualitatively. Using the method of SGR quantitative evaluation, backbone boundary fault and 18 faults are analyzed systematically. And we evaluate traps at fault slope belt.

5.3.1Lateral sealing ability of fault analysis

TB78 fault is a main fault which control fault block traps at Wuerxun eastern slope belt. It control the hanging wall of lasi-7 trap and the heading wall of lasi-26 trap(Fig.5).

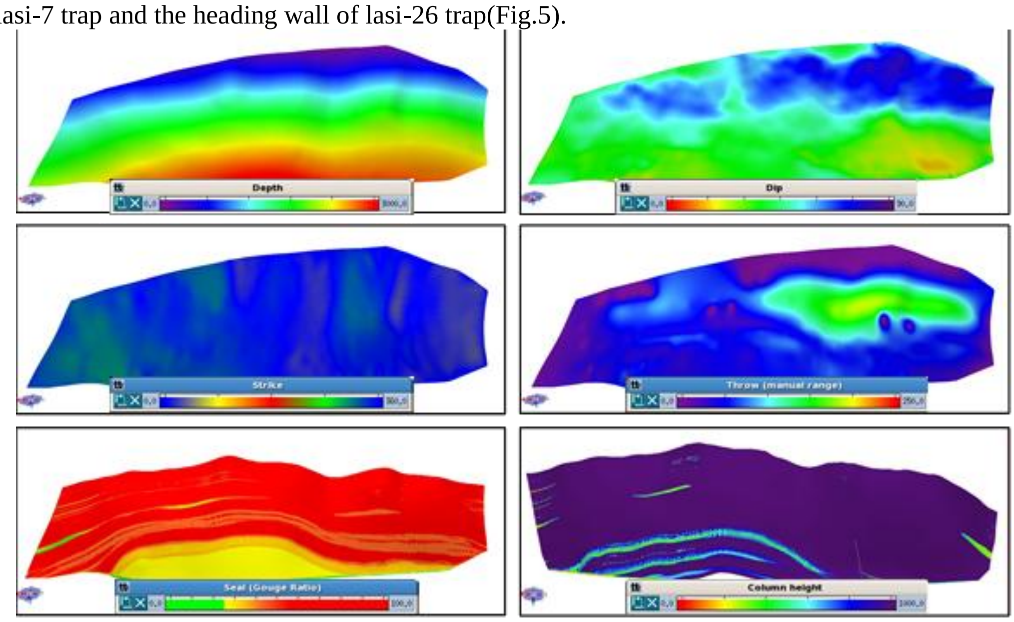


Fig 5 Fracture section properties

From the fault plane lithologic juxtaposition map, the area of the joint of sands fault TB78 plane is developing. So it’s difficult to seal ,only by lithology joint. Statistics show that SGR of the fault plane is 59%. Fault has a good ability of lateral sealing.

5.3.2Lateral sealing ability of fault and its relationship with oil-water

From the trap structure diagram and the trap elements table in the study area can be seen that the faults in the study area is developed. At present the development of trap structure without exception are associated with fault[5]. In most cases , Two or more than two faults control fault block traps. There is no doubt that the research and exploration trap need to explain fault firstly.

On the basis of the above work, we select the fault block traps in the study area for estimation of hydrocarbon column height and the oil-water interface. For example, In No.6 structure , we introduced evaluation process of Wuerxun eastern slope belt lateral sealing ability of faults quantitatively in detail. No.6 fault block traps s are mainly controlled by two fractures . Lateral seal ability of faults directly affect the scope of effective traps. Therefore, it is very necessary to evaluate the fault lateral risk.

According to the already slope with lower limit of SGR (25%), we simulated calculations. Calculating the height of hydrocarbon column that fault plane can support, we Located interface of reservoir oil-water. By comparing predicted oil-water interface and drilling confirmed actual interface , we know that the predicted results are real.

VI. CONCLUSION

According to the already slope with lower limit of SGR, we simulated calculations. Calculating the height of hydrocarbon column, Locating interface of reservoir oil-water，then we compared the results with the actual interface. We concluded that predicted results are real.

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