

Main factors controlling hydrocarbon accumulation of Dongying Group in Liuchu area

Wang Wei¹

1 (College of earth science of Northeast Petroleum University, Daqing, Hei Longjiang, China)

Abstract: In order to satisfy the further exploration work of Liuchu area, we discuss main factors controlling hydrocarbon accumulation of this field. We use the method of combination of hydrocarbon distributions and accumulation conditions to study the hydrocarbon accumulation, distribution pattern and the main factors of Liuchu area. The results show hydrocarbon accumulation is controlled mainly by oil source faults, the sealing of the caprock and the reservoir property. According to the distribution of water and hydrocarbon, this field is source accumulation-forming model. First, hydrocarbon is vertical migration through source faults, and is lateral flow in condition that the sealing ability of caprock is good, and the hydrocarbon will migrate a short distance in the sand body of reservoir and accumulate. This conclusion provides a theoretical basis for further exploration in Liuchu area.

Keywords: oil source fracture, caprock, fault concentrated belt, main factors controlling.

I. INTRODUCTION

Liuchu area is south-central in Raoyang Sag of Bohai bay basin, and is 515km², and it is asymmetrical collapse anticline in northeast-trending. This field develops Kongdian paleogene, Shahejie formation, Dongying, neogene Guantao, Minghuazhen and Quaternary from bottom to top. The main purpose of the present study layer is Dongying group. By analyzing predecessor's finishing awareness about source rock and oil source correlation in Liuchu area, we can see that hydrocarbon is mainly from the 1st member of Shahejie formation, and some is from the 3st member of Shahejie formation. Since the layers are separated by shale between the source and reservoir rock, hydrocarbon cannot be directly migrated upward through the overlying reservoir pore and permeate only by the source faults moving to the reservoirs^[1-4]. So the layer which hydrocarbon gathers in, the places where hydrocarbon gathers in plane and main factors controlling hydrocarbon accumulation are crucial to the further exploration work of Liuchu area. There are many conclusions about oil source faults and its control on hydrocarbon accumulation, but these are about characteristics of oil source fracture, type, and distribution of hydrocarbon accumulation relations in Jiyang Depression of Bohai Bay Basin^[5-6] and Sanzhao depression of Songliao Basin^[7-8]. And there are few research about accumulation Controlling factors of Liuchu area of Raoyang Sag. Therefore, we discuss the oil source fracture and main factors controlling hydrocarbon accumulation of Dongying group in Liuchu area. It is important to the law of hydrocarbon accumulation in the study area and to guide hydrocarbon exploration.

II. VERTICAL TRANSPORTING OF OIL SOURCE FRACTURE

Three-dimensional seismic interpretation results show that there are a large number of faults in the middle-shallow layers of Liuchu area. But not all faults can be migration pathways for the the hydrocarbon from the 1st and 3rd member of Shahejie formation to the middle-shallow layers, and only some faults that Communicate with source and reservoir and are is open in accumulation period are oil source fracture of hydrocarbon migration pathways. According to Hydrocarbon threshold and TOC, source rocks are divided into three types: high efficient district when they reach hydrocarbon threshold and TOC is greater than 0.8; efficient district when they reach hydrocarbon threshold and TOC between 0.4 and 0.8; low-non efficient district when they don't reach hydrocarbon threshold. High effective source rocks in Es1 layer are mainly distributed in the northern region of the study area (Fig.1). The area of effective source rocks is reduced from northeast to southwest and is banded. The anticline in Liuchu area contains many effective source rocks. The range of high effective source rocks in Es3 layer is small and is mainly distributed in the northeast region of the study area. The areas of effective source rocks are southeast and northeast. Then the faults between reservoir and source could be further subdivided according to the types of source rock. The main faults between reservoir and source are the connections between the reservoir and Es1x low effective source, the reservoir and Es1x high effective source or Es1x high effective source and Es3 low effective source. These faults act as basic conditions of the hydrocarbon migration upwards from Es1 or Es3 source in vertical direction.

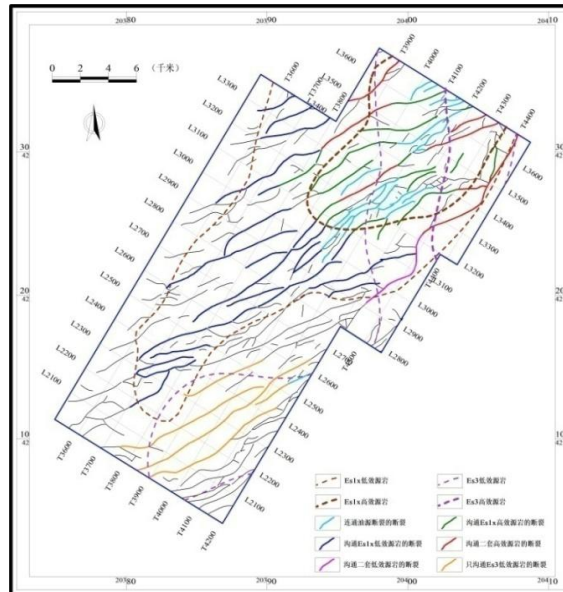


Fig.1: Distribution of hydrocarbon source rocks and oil source fracture of the Ed₃ in Liuchu area

III. THE CHARACTERISTICS OF CAPROCK DEVELOPMENT AND ITS CONTROL FUNCTION OF RESERVOIR FORMING

There are three seal stratum, which thicken from the core area to the anticline wings, developed in Dongying Group, in which the thickest stratum is Ed₁₊₂. The seal thickness is not coincides with the seal ability of the reservoir based on the comparison between the seal thickness map and the reservoir distribution. Therefore, it is not reliable to use the seal thickness to predict the seal ability. However, the thickness ratio between the mud and the stratum is consistent with the seal ability after comparison. The thickness ratio between the mud and the stratum affects the purity of mud in the seal, and the higher the ratio is, the stronger homogeneity these stratums has, in another word, the trap is hard to be broken. Based on 62 statistic results from S1 stratum of Dongying group in Liuchu area, probability of oil seal can reach 90% when the ratio is beyond 0.8. So the seal stratum is the decisive factor for hydrocarbon from vertical migration to horizontal migration, and also the controlling factor for the trap formation in the study area (Fig.2).

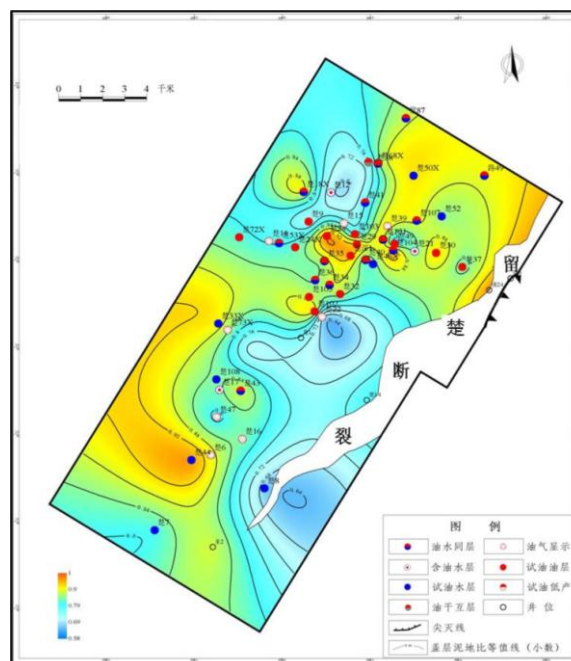


Fig.2: The contour map of ratio between the mud and the stratum of the Ed₃ in Liuchu area

IV. FAULT CONCENTRATED BELT CONTROLLING HYDROCARBON ACCUMULATION IN THE CORE OF COLLAPSE ANTICLINE

The fracture is usually densely distributed, which can form a strip in a plane, forming a fracture zone. In the Fault concentrated belt of the study area fault distance is about 300-600m. So in the fault zones to small and dense nuclear part is easy to fracture configuration perpendicular or oblique to the formation of fault block. Note to the wall charge along the oil source faults of oil and gas accumulation is easy to be blocked. More than two of the oil and gas distribution in the area is more than 1.5 of the area where the density is greater than 3 when the density is more than 90%, more than of the oil well. The oil and gas distribution in the three section of the East three section is mainly distributed in the area with an internal fracture density greater than 2. On the whole, the two section of the sand in Chu area is mainly concentrated in the area of the core of the collapse of the collapse of the core of the core of the collapse of the dense zone with a density of more than 2 of the area. So the fault zone is the favorable area for oil and gas enrichment. At the same time, according to the control of the late fault activity rate of drilling traps and oil well with good relationship, it can be known that the activity rate is less than 4.1m/Ma, which is favorable for hydrocarbon preservation. The fault activity strength of the fault in the core of the core of the collapse is weak, which is favorable for the preservation of oil and gas in the area. As a result, the core of the collapse in the study area is controlled by the dense zone of the core of the oil and gas zone (Fig.3).

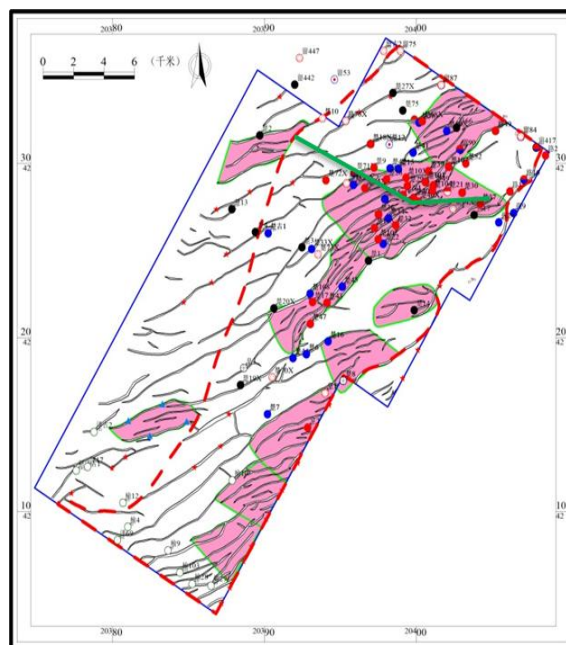


Fig.3: Fracture zone and oil and gas superposition map of Dongying group

V. CONCLUSION

- 1) Liuchu area shallow layer belongs to the oil source faults and "Down generated up stored" source-reservoir-cap assemblage. Hydrocarbon accumulation model is that underlying Shahejie group 1 segments or Shahejie group 3 segments oil and gas generated by the source rocks migrate along the oil source fault to the overlying middle layer. Because of barrier of three sets of mudstone caprock of Dongying group, oil and gas migrate and accumulate in lateral flow in the underlying strata.
- 2) In the process of oil and migrate upward along the oil source faults. When encounter the regional cap rock it will be diverted to the lateral reservoir. After entering the reservoir, the oil and gas is easy to be concentrated in the fault zone of the core of the collapse anticline, which main reasons are two aspects: ①The density of the fault is relatively large, and it is easy to form the lateral occlusion and prevent the migration of oil and gas in the fault crowd zones. ②The active strength of the fault is weak and the oil and gas is easy to be stored in the fault crowd zone.

VI. ACKNOWLEDGE

The project is supported by Northeast Petroleum University Innovation Foundation For Postgraduate (serial number: YJSCX2015-003NEPU)

REFERENCE

- [1] Fu Guang, Wang Yougong, Yuan Dawei. Source faults of F, Y oil layer in Sanzhao and its control to oil accumulation[J]. *Acta Petrolei Sinica*, 2010, 31(5): 762-766.
- [2] Fu Guang, Wang Yougong. Migration horizons downward of oil from K1qn source rock of F, Y Oil layer in Sanzhao depression and its significance[J]. *Acta Sedimentologica Sinica*, 2008, 26(2): 355-360.
- [3] Fu Guang, Guo Jinsi. The favorable conditions for oil accumulation of K1n1 in main depression zones of central Haita basin[J]. *Journal of Shandong University of Science and Technology: Natural Science*, 2012, 31(4): 1-9.
- [4] Shi Lizhi, Wu Heyong, Lin Tiefeng, et al. Characteristics of hydrocarbon migration in Fuyang oil layer in Daqing Placanticline and its western area in Songliao Basin[J]. *Acta Petrolei Sinica*, 2010, 31(5): 762-766.
- [5] Zhang Shanwen, Wang Yongshi, Shi Dishu, et al. Meshwork-carpet type oil and gas pool-forming system: Taking Negene of Jiyang depression as an example[J]. *Pertroleum Exploration and Development*, 2003(2): 1-10.
- [6] Fu Xiaofei, Ping Guidong, Fan Ruidong, et al. Research on migration and accumulation mechanism of hydrocarbon "reversed migration" in Fuyu and Yangdachengzi Formation in Sanzhao depression[J]. *Acta Sedimentologica Sinica*, 2009, 27(3): 558-566.
- [7] Wang Yachun, Zhao Jintao, Wang Meiyun. Mechanisms of oil migration and accumulation in F, Y oil layers of south Songzhan region, Songliao basin[J]. *Acta Sedimentologica Sinica*, 2009, 27(4): 752-759.
- [8] Wang Jianwei, Song Guoqi, Song Sujun, et al. Controlling factors for petroleum dominant lateral migration along Eocene carrier beds in southern slope of Dongying Sag[J]. *Earth science*, 2009, 33(5): 36-40.