**IOSR Journal of Engineering (IOSRJEN)** **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
Vol. 05, Issue 06 (June. 2015), ||V1|| PP 18-22

# Study on the characteristics of the lower Cretaceous reservoir in the Yan Ji Basin

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**Abstract: -** *Yanji basin is a Mesozoic Cenozoic rift basin, which mainly developed lower Cretaceous layer. Studying the characteristics of the lower Cretaceous reservoir has an important theoretical significance for petroleum exploration in this area. Through scanning electron microscope, casting thin sections, ordinary slice and the studying the files of porosity and permeability,this essay analyzes in detail the characteristics of the reservoir rocks in the lower Cretaceous of Yan Ji basin, and studied systematically the effect of the diagenesis of the lower Cretaceous reservoir on reservoir's physical property as well.The results show that the sandstone reservoir rocks in the lower Cretaceous of Yan Ji basin are feldspar sandstone, feldspar sandstone and feldspar debris sandstone.The overall density of the reservoir is dense and particle slightly better, the physical grade should belong to the low porosity and extra-low permeability;The prime factors affecting the physical properties of reservoir is diagenesis .The main diagenesis types include mechanical compaction, cementation, dissolution.*

***Keywords:*** *Yanji Basin, Lower Crataceous, Reservoir physical property, Controlling factor*

## I. INTRODUCTION

Yan Ji Basin is located in the east of Ji Lin Province, Yanbian Korean Autonomous Prefecture, the geographical coordinates is between 129°00′-129° 45' east longitude and 42°30′-43°north latitude.The length of the basin from east to west is about 40km,the length from south to north is about 50km,measures about 1670km$^2$.The drilling revealed the fact that the Cretaceous layer is well developed, it's a set of lacustrine facies and fluvial facies clastic sediments.Its total thickness is counted more that 4000m[1].The layer of the lower Cretaceous in ascending order are:lower Tun Tianying group (Kltn),Chang Cai group(Klc),Tou Dao group(Kltd),Tong Fosi group(Klt),Da La group(Kldl).The main exploration target layers are Tong Fosi group and Da La group.In those two set of layers developed abundant and diverse fossils and dark mudstone ,oil generating potentiality is very high.Hydrocarbon show exists in several wells.

The Yanji basin,a basin in the periphery of Daqing,is the main petroleum basin of processing the new round of the petroleum resources evaluation all over the nation.The lower Cretaceous is the main sedimentary layer in the basin, and it is the key stratigraphic horizon of the petroleum exploration.After a decade's exploration,10 more wells are drilled in the Yan Ji basin.In the lower Cretaceous sandstone,small amount of oil flow is seen in Tong Fosi group.Commercial hydrocarbon flow is found in the sandstone of Da Lazi group [2].While the reservoir is the main study object of the oi-gas exploration and the low porosity and low permeability reservoir is the new hydrocarbon exploration goal, and also the difficulty on oil gas reservoir research.Therefore, the identification of the characteristics of the lower Cretaceous reservoir is of great significance and value for the exploration of oil and gas in this area, and provides direction for the next exploration target.

## II. CHARACTERISTICS OF THE RESERVOIR & PORE TYPE

### 2.1 Rock composition of the Reservoir

According to the observation of core and the analysis of rock slices, the reservoir lithology of the lower Cretaceous in Yanji basin is basically the same;The rock types of sandstone reservoir are arkose , debris-feldspar and feldspar-debris sandstone.The main components of clastic are feldspar,debris and quartz[3].Usually,The

content of the quartz usually is 20 %-50%,up to 65%,average to 35 %.The content of the feldspar usually is 25%-75%,up to 80%,average to 40 %,its main ingredients are orthoclase(carlsbad twin),with little plagioclase.The content of the rock debris usually is 25%-50 %,up to 75%.The prime content of the cement is calcium, which contains calcite, ferrocalcite,with a content of 1%-25 %, and the content of the mudstone matrix is also high reached to 1%-10%.

**2.2 Physical Property of Reservoir**

Effect of fluid flow in the reservoir to a number of factors, including porosity, permeability, saturation, capillary pressure, wettability and impermeable layer distribution.While among various factors,the influence of porosity and permeability are of great importance,that's why normally the reservoir physical property is mainly reflected by the physical parameters, porosity and permeability.In this essay,the classification of reservoir physical property[4] could be seen in Table 1,combined with pore structure,pore origin , environment geochemistry ,the reservoir physical property was grade five.

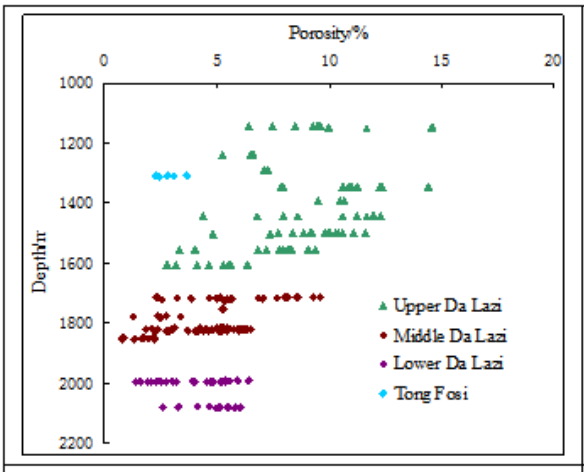
Table1 Grade Parameter of the Reservoir Physical Property

| Grade | Porosity | | Permeability | | Type |
|---|---|---|---|---|---|
| | Code | Parameter values /% | code | Parameter values /$\times10^{-3}\mu m^2$ | |
| Grade One | $\varphi_1$ | >30 | $K_1$ | >2000 | super-high porosity and super-high permeability |
| Grade Two | $\varphi_2$ | 25-30 | $K_2$ | 500-2000 | high porosity and high permeability |
| Grade Three | $\varphi_3$ | 15-25 | $K_3$ | 100-500 | medium porosity and medium permeability |
| Grade Four | $\varphi_4$ | 10-15 | $K_4$ | 10-100 | low porosity and low permeability |
| Grade Five | $\varphi_5$ | <10 | $K_5$ | <10 | super-low porosity and super-low permeability |

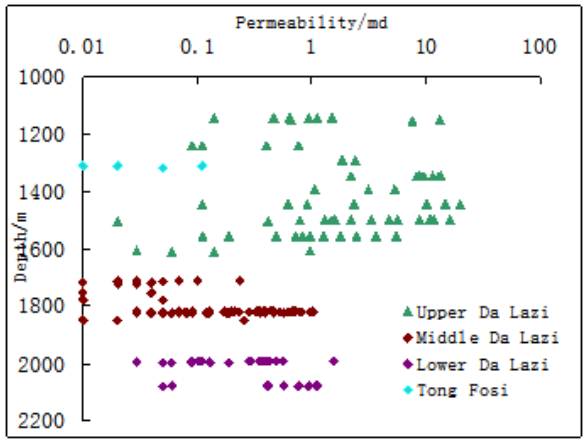
There are10 wells,a total of of 364 porosity data in the lower Cretaceous of Yanji basin,we could get the range of porosity distribution.Tong Fosi group's porosity data distribution range is0. 9%-23.2%,12.8%on average(Pic1.1),the numerical values are mainly distributed between 2%-15%,which belongs to the range of medium-low porosity.There are 754 effective data for the permeability of the lower Cretaceous in the basin of Yan Ji Basin, the data distribution range is 0. 01-528 ×10 -3μm$^2$,4. 74×10 -3μm$^2$ on average(Pic1.2),the numerical values are mainly distributed in the range below 10 ×10 -3μm$^2$,which belongs to the range of extra-low permeability.As a result,the overall density of the Cretaceous reservoir of Yan Ji basin is dense ,its particle is slightly better.The physical grade of physical property should belong to the low porosity,the extra-low permeability kind, possessing a certain reservoir property.

2.3 Pore type

According to Di Shixiang etc.(1991)Clastic pore classification method and Shamugam(1985) identification of pore types[5],through the observation of core, casting thin sections,ordinary slice,cathodoluminescence and scanning electron microscope, we summarized the porosity of the sandstone reservoir in the lower Cretaceous from the studying area as::intergranular pore, intergranular dissolution pore(super dissolution pore), innerparticle dissolution pore,interstitial content dissolution pore.




Pic 1.1 Porosity-Depth map of the lower Cretaceous of Yan Ji basin




Pic 1.2 Permeability-Depth map of the lower Cretaceous of Yan Ji basin

## III. INFLUENCING FACTORS OF RESERVOIR PHYSICAL PROPERTY

There are various of factors that have influence on the physical propertyof reservoir.Such as tectonic function, sedimentary environment and diagenesis, etc[6].By studying the Yan Ji Basin,we realize that sedimentary environment and diagenesis are the main factors which could affect the physical property of reservoir,especially the latter.

### 3.1Sedimentary Environment

Sedimentary microfacies is a crucial indicator to the hydrodynamic environment of the sedimentary environment.Sedimentary environment has an obvious influence on the reservoir rocks of the lower Cretaceous[7].Its main features are as follows: In the middle-low level porosity, the frequency of the micro phase of the underwater distributary channel is the highest.That is because the micro phase of the underwater distributary channel is mainly under the control of the river and wave,it often represents a relatively strong hydrodynamic environment.Under this hydrodynamic environment,the separation and rounding of reservoir sandstone is tend to be good, and the shale content are little.Not only providing the reservoir with a comparatively high initial porosity ,but also reducing the possibility of heterobase plugging the pore throat,providing the fundamental conditions for forming high-quality reservoir.Besides, the underwater distributary channel facies distribute lots of super-low porosity and super-low permeability kind of poor reservoir.This might because of the destruction of the late diagenesis to the reservoir[8].

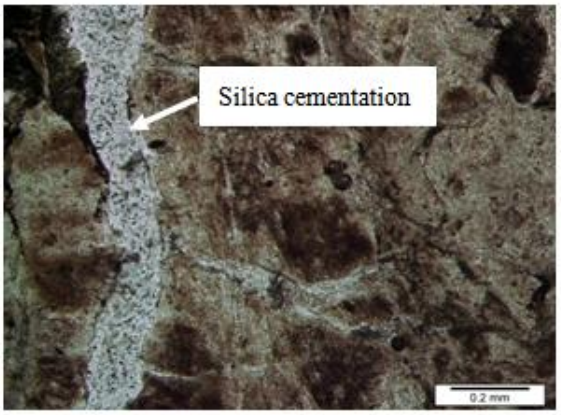
### 3.2 Diagenesis

**①Mechanical compaction**

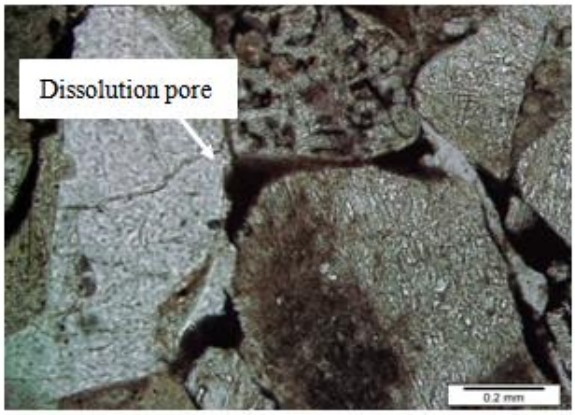
Compaction occurs in every stages of diagenesis.As long as the upper layer provides pressure,it could result in the sediment discharging gas and water, volume reduction, porosity reduction, density increase, the sediments solidified into rocks as a consequence.Normally,the pressure of the layer increases when the depth of the sediment increases or the thickness of the overlying layer increases.So the degree of compaction is increasing with the growing of depth, with the increasing of pressure, the rock grains may rupture or have ductile deformation.

②Cementation

The cementation type of rock in the study area can be concluded as carbonate mineral cementation ,silica cementation.(Pic3.1),laumontite cement and the cementation of clay minerals[9].The filling of cements in the pore leading to the decrease of the porosity,while in the later period the dissolution has a destructive effect on the dissolution of cements,resulting the release of the reservoir space.




Pic3.1 Silica cementation




Pic 3.2 Acid Fluid Dissolution Feldspar

③Dissolution

The dissolution in the Yan Ji basin are mainly happened among feldspar,micritic calcite cement and laumontite cement.The dissolution of feldspar and micritic calcite is well developed in some drilling wells[10,11].Calcite cement and feldspar are prone to dissolute under the impact of acid fluid of formation(Pic3.2), the the secondary porosity of reservoir is increased as a result of this.

④Fractures

There are a lot of fractures in the research area.The results of core, ordinary slice observation and physical property analysis indicate that the fracture development improves the reservoir physical property.We can see this in two aspects:For one thing, the fracture development provides lots of porosity, which can improve the reservoir property;For another thing,the development of the fractures provides a path for fluid migration (especially the acid fluid),and then provides the conditions for improving the reservoir physical properties[12].In addition,a large amount of calcite and laumontite developed in the fractures of the Yan Ji basin , which means the fractures suffering the impact of diagenesis after its formation, making its ability of improving the reservoir physical properties greatly reduced.This is the very primary reason for the fracture well development in the Yan Ji basin while the reservoir space remains poor.

## IV. CONCLUSION

According to the study above,we have drawn the following conclusions :

(1)The sandstone reservoir rocks in the lower Cretaceous of Yan Ji basin are feldspar sandstone, feldspar sandstone and feldspar debris sandstone.

(2)The physical properties of reservoir are relatively low, and mainly are low porosity and low permeability. Da Lazi group has a slightly advantage physical property of reservoir than that of Tong fosi group.

(3)There are four pore types of sandstone reservoir in the studying area:intergranular pore, intergranular dissolution pore(super dissolution pore), innerparticle dissolution pore,interstitial content dissolution pore.

(4)The prime factors affecting the physical properties of reservoir are sedimentary environment and diagenesis,particularly the latter has a larger influence.The main diagenesis types we know are mechanical compaction, cementation, dissolution as well as fracture. The cementation among those are the main diagenesis which affecting the sandstone reservoir rocks in the lower Cretaceous of the Yan Ji basin.

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