

# The study of reservoir heterogeneity in Shu127 block of Yushulin Oilfield

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**Abstract:**-Based on the comprehensive analysis of geological data in the study area, through the calculation of shu127 block Putaohua reservoir variation coefficient Onrush coefficient and other parameters. By researching the heterogeneity parameters, interbeds and rhythm, we conclude that the heterogeneity of inner layer is serious.

**Keyword:**-reservoir, heterogeneity, Interbeds,

## I. GEOLOGICAL CONDITION

Yushulin oilfield is a part of Shangjia nosing structure, location is near the Zhaodong City, Heilongjiang Province, the northeast is shangjia oil field, the North, West, South next to the Wang Jiatus gas field, Sheng ping gas field, Zhao zhou oil field and Chaoyanggou Oil field. Latitude is 45°53'00"N~46°10'00"N, longitude is 125°22'45"E~ 125°41'00"E (Fig.1). Regional tectonic depression belongs to the Xujiaweizi Syncline in the eastern slope zone three Zhao of the central depression in Songliao Basin. The tectonic pattern is a single lean to the southwest from the northeast. Its formation is mainly controlled by the renminzhen-zhaozhou fault zone. Shu 127 belongs to the West end of Yushulin Oil Field.

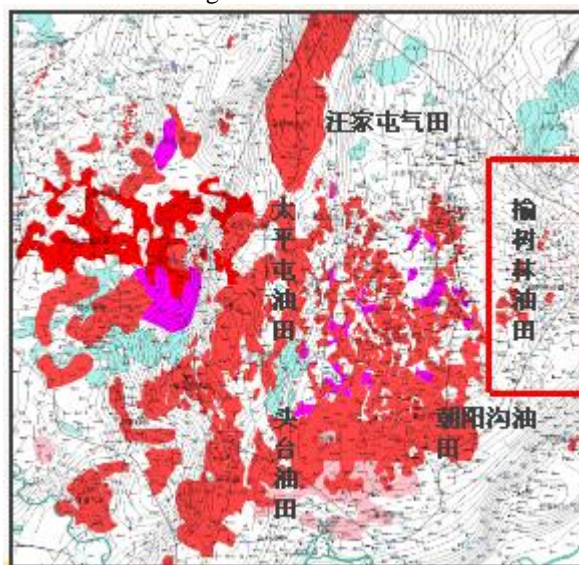


Fig.1 Location of yushulin Oilfield

## II. INTRAFORMATIONAL INHOMOGENEITY

Reservoir intraformational inhomogeneity is a variation of the internal properties of single sand reservoir in vertical upward. It is the key geological factor that influence the volume of Single sand vertical injection agent. Intraformational inhomogeneity includes particle size rhythm, permeability rhythm and the highest permeability layer position, bedding structure and permeability anisotropy, the interlayer and layer permeability inhomogeneous degree, etc.

Intraformational inhomogeneity mainly refers to two aspects. First of all, the highest permeability section position, that is at the bottom, the top or the middle of layer, and the differences between the degree of permeability of each section. Secondly, a single sand vertical permeability and horizontal permeability ratio is an important factor to determine the vertical fluid stream. By the inner layer permeability heterogeneity degree of the reservoir heterogeneity to indicated the research about the heterogeneity of layer, which is one of the important parameters for the study of heterogeneity in current characteristics. Generally, intraformational heterogeneity can be analyzed from the vertical particle size distribution, the interlayer and the inner layer permeability heterogeneity.

### 1.PermeabilityRhythm

The vertical directionchange of the intraclast in single sand body is called particle size rhythm.It iscontrolled by sedimentary environment and sedimentation.Particlerhythm is generally divided into four categories, such as positive rhythm,inverserhythm, compoundrhythm and homogeneousrhythm.The existence of rhythm is related to the strength of the water.

The rhythmic reservoir permeability distribution can be divided into simple rhythm, positive rhythm and compound rhythm (Fig.2), Layer permeability effect the difference on the spatial distribution of petroleum ,the water logging and the oil displacement efficiency.Therefore, it is easy to distribute the remaining oil in the low permeability zone, especially in the upper part of the positive rhythm.

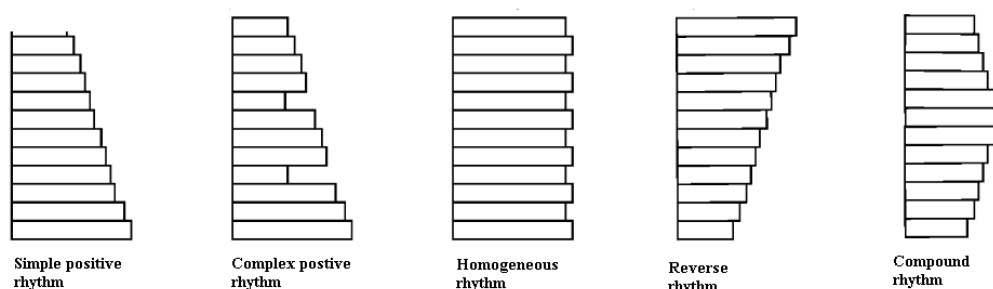


Fig.2 The vertical distribution pattern of permeability

### 2. IntraformationalInterbeds

The distribution of theinterbeds is very important influence to thedistribution of oil water.In the injection production well, the distribution of the interlayer can play a role in shielding the oil -water, if unstable layers too much, so it shows that the heterogeneity is stronger, oil-water distribution more complicated. Therefore, reservoir heterogeneity is mainly determined by the development of the interbeds.

In general, there are two parameters, one is the frequency of the interbeds, the other is the density of the interbeds. The frequency of the interbeds refers to the number of interbedsunits in every thickness of strata. In the thickness of the strata, the number of interbeds are more,which shows the changes of the sedimentary micro environment and the grain size of the sedimentary reservoir is more frequent.It means the physical properties will be changed,too.The density of the interbeds is the ratio of the total thickness of the sandstone section to the total thickness of the interbeds in the section.

Through the research and analysis of core data and well logging data,we could draw a conclusion that the interbeds of the study area is mainly based on the muddy layer.The parameters of the interbeds are shown in Table.1

Table.1 Statistics of Shu 127 reservoir interbeds parameters

layer	Interbeds thickness ( m)			The density of the interbeds (%)	the frequency of the interbeds (strap/meter)
	minimum	maxmum	average		
PI11	No interbeds				
PI12	No interbeds				
PI2	0.6	1.2	0.9	36	0.36
PI3	0.6	2.8	1.35	46	0.3
PI4	0.4	6.8	1.47	37	0.3
PI51	0.4	4	1.75	42	0.28
PI52	0.4	3.6	1.81	40	0.2
PI61	0.6	4.6	2.36	44	0.25
PI62	1.2001	1.2001	1.2001	75	0.625

According to the statistical table of the interbedsparameters,The average frequency of the study area is 0.33 starp/ meter, and the average density is 46%.The smaller parameters of the reservoir, the heterogeneity of the reservoir is weak, the properties of the reservoir is better.The distribution of the interbeds directly affected by sedimentary microfacies and the swing of the Channel during the deposition period.So the development of the interbeds is different in different facies.Therefore, PI3,PI4,PI51, PI51 and PI61can be used as the main oil reservoir layer to exploiting.

### 3. Intrastratal Heterogeneity Parameters

Heterogeneity in layer permeability horizontal permeability of vertical to varying degrees, quantitative description of the important content of reservoir heterogeneity can be a permeability variation coefficient, permeability of the onrush coefficient and permeability range to represent.

Due to the reservoir heterogeneity on waterflooding sweep efficiency has great influence. Therefore, usually reservoir permeability is good or bad for evaluating non homogeneity of the standard, through the study on the anisotropy of the permeability to reveal the essence of the reservoir heterogeneity of reservoir. Permeability variation coefficient is in layer permeability value relative to the average degree of dispersion or change degree and permeability variation coefficient, permeability onrush coefficient, the extremely poor permeability, the three parameters to estimate the reservoir permeability heterogeneity is usually adopted. The maximum value, minimum value and average value of the permeability are expressed by the permeability. According to the standards specified by the CNPC, the evaluation principles of the reservoir heterogeneity are as shown in table 2.

Table.2 The reservoir permeability heterogeneity parameters

Parameter		coefficient of variation ( $V_k$ )	Onrush coefficient ( $T_k$ )	Permeability contrast ( $J_k$ )
definition		$V_k = \frac{\sqrt{\sum_{i=1}^n (K_i - \bar{K})^2 / n}}{\bar{K}}$	$T_k = \frac{K_{max}}{K}$	$J_k = \frac{K_{max}}{K_{min}}$
Standard	Homogeneous reservoir	<0.5	<2.0	<2.0
	Medium heterogeneity	0.5~0.7	2.0~3.0	2.0~6.0
	Strong heterogeneity	>0.7	>3.0	>6.0

Figure shows the study area permeability parameters variation coefficient and onrush coefficient are inhomogeneous, reservoir range belongs to strong heterogeneity reservoir, indicating that the reservoir heterogeneity is strong

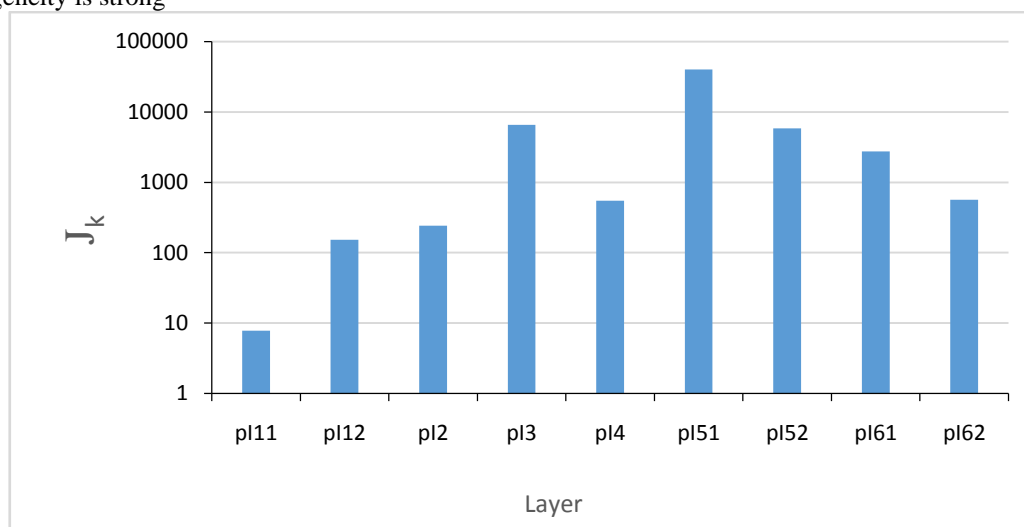


Fig.3 The histogram of permeability contrast

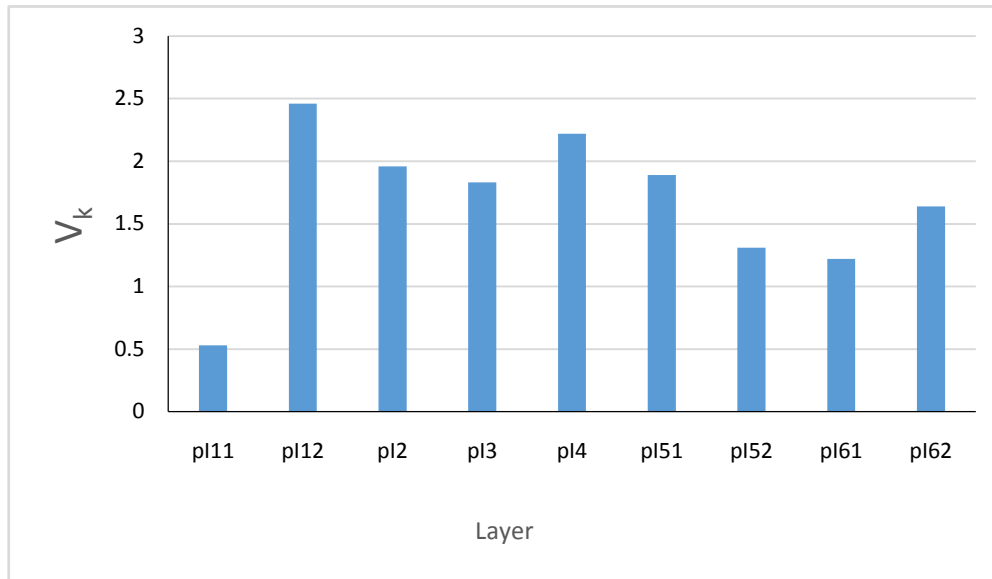


Fig.4 The histogram of coefficient of variation

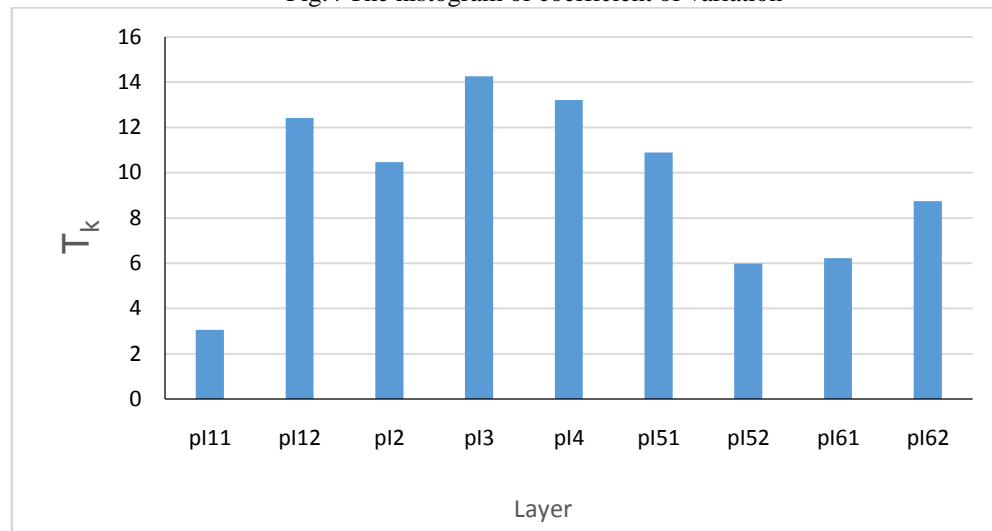


Fig.5 The histogram of Onrush coefficient of permeability

### III. CONCLUSION

According to the analysis of heterogeneity in study area, we could draw conclusion that the interformational heterogeneity displays well-developed interbeds and weak vertical continuity. A series of sand bodies are composed of several cycles. silt or mud interbedding usually exists between cycles, which means the reservoir heterogeneity is strong.

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