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Watered-out Reservoir Parameter Interpretation Research of Xingnan oilfield Development Area

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Abstract: **-** After water injection, water content of reservoir rises gradually, heterogeneity and high water-containing nature reduces the efficiency of water injection. Based on the oil reservoir characteristics of Xingnan Development Area pure oil zone, this article develops a set of reservoir thickness division, reservoir parameter calculation and automatic interpretation of the comprehensive reservoir evaluation method, providing the basis for oilfield development adjustment. Using the method above to calculate the reservoir parameters, such as porosity, permeability and irreducible water saturation, the results show to meet the data measured by coring well, thus this method can provide the accurate data for the fine geologic description. The principle is simple and clear, which has achieved good application effect in Xingnan development area and can be extended to other area with the description and evaluation of reservoir with strong heterogeneity of other area which adopts the water flooding method.

Keywords: **-** Xingnan oilfield ,reservoir parameters, thickness division, porosity, Saturation

Ⅰ. REGIONAL GEOLOGICAL SURVEY

1.1 sedimentary characteristics

Xingnan development area of pure oil reservoir layer is located in the south of Daqing Changyuan Xinshugang anticline structure, and Xingnan oilfield deposits of Quaternary system and lower cretaceous including nenjiang group, yaojia and qingshankou formation. The whole reservoir has developed Saertu and putaohua oil layer, Pu 12-3 functions as the major reservoir, the others are non-main reservoir. Major reservoir is generated from the delta dis-tributary plain facies and inside front facies, sand body is located in the strip, block distribution; Except Pu 1 non-major reservoir, the rests are outside the delta front facies, sand body or a sheet, local article belt in scattered. Reservoir types are structural reservoir, belonging to anticlinal structure, faults are all normal faults, most of the faults strike to the north west.

1.2 the reservoir development characteristics

Sedimentary type is mainly the front sheet sand sedimentary sand body and delta distributary channel deposits, particle size is mainly powder sandstone, fine sandstone, with gray, celadon mud powder sandstone and argillaceous siltstone. Reservoir between cement particles is mainly muddy sediment, pore is mainly with inter-granular pore, oil-bearing occurrence is mainly with oil sands, effective porosity is mainly range in 21.5 29%, average air permeability is 0.452 mu (m2), the original formation water salinity is around 7500 PPm, after many years of water flooding development, the formation water salinity in2500-4500 parts per million or so, in the later period of high water content, in this paper, according to the characteristics of apricot southern oilfield reservoir division method to establish reservoir thickness division, reservoir parameter calculation method, formed the apricot southern oilfield water flooded layer automatic interpretation processing technology.

Ⅱ. THE PRINCIPLE OF LOGGING CURVE DIVISION VALUES ACQUISITION

2.1 curve hierarchical principle

With high resolution 3 lateral or micro-normal logging curves as the benchmark curve, other curves use this the standard curves as the standard, layering all curve manually and the theoretically. Use Micro spheres, high resolution three lateral, micro potential three logging curves as a natural potential identification of mud stone point conditions.

For different logging series discriminant, adopt natural potential for mud stone, a natural potential curve shall meet the requirements of certain thickness at the same time, on the basis of mud stone points divided into natural potential baseline.

2.2 active layered division method

Active function is defined as:

$$E(d) = \int_{d-\frac{w}{2}}^{d+\frac{w}{2}} \left[f(x) - \overline{f(d)} \right]^2 dx \tag{1}$$

formula:

f (x) -- the depth of the curve of the x value

E (d) -- activity at depth d value

w -- filter window

Actually it can be used the following a derived after the standardization of active function:

$$A(d) = tg^{-1} \frac{3E(d)}{n(n+1)(2n+1)} \bullet \frac{B}{|L-R| \bullet rlev \bullet ps/100} \tag{2}$$

Among them:

B -- channel width on the diagram

|L-R| - - The absolute value of left right scale difference

rlev-- sampling spacing

ps --100 depth unit distance on the curve

Such A (d) function can provide continuous value on the activity of curve, the range is 0 ~ 90 degrees, in order to eliminate noise effects, it needs to smooth the curve after the calculation of activity, curve of the interface point is greater than a certain threshold value activity of maximum point.

2.3 curve evaluation methods

Select the geometric thickness weighted average values: when a layer is composed of multiple peak valley, according to different use curve, then the layer of values can be according to the value of the peak valley and their corresponding contribution with a thick layer of decision.Now the computer automatic layering values using the above method.

$$x = \frac{\sum_{i=1}^{i=n} x_i * h_i^m}{\sum_{i=1}^{i=n} h_i^m} \quad (3)$$

Among them:

X - The value of the layer results

m - geometric weighting factor

hi - corresponds to the thickness of the i layer peak or valley

Xi, the corresponding value of the i layer peak or valley

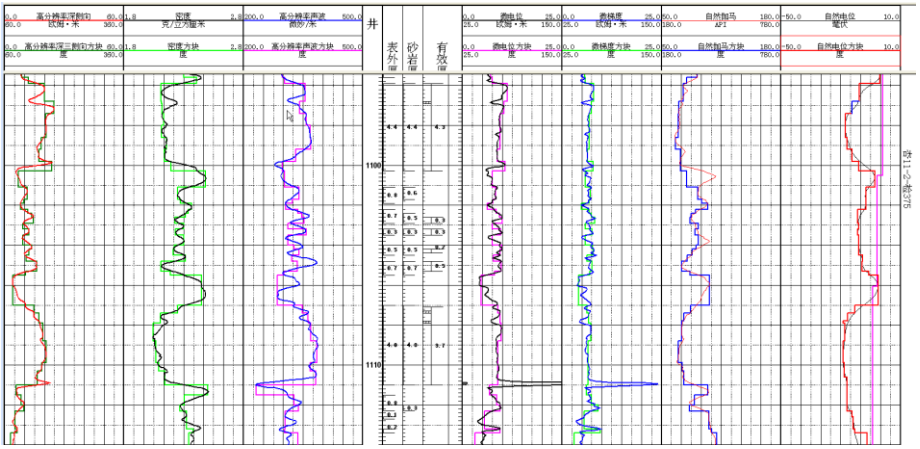

Fig.1 Xingnan oilfield X well points effectively, off-balance-sheet curve of different types of reservoir thickness layered instance values

Ⅲ. RESERVOIR PARAMETER CALCULATION METHOD RESEARCH

Xingnan Development area reservoir layer has Saertu, Putaohua oil layer.Overall Saertu oil layer of Xingnan development area of pure oil reservoir sediment is mostly argillaceous sandstone and argillaceous siltstone and silty mudstone, poor permeability, as for putaohua reservoir because deposit is the more channel sand body, the lithology has better properties.

In order to accurately describe the reservoir physical parameters to improve the interpretation precision. According to Xingnan development area based geological sedimentary characteristics and reservoir lithology, physical property features, will explain the reservoir property of reservoir effective thickness subdivided into Saertu and putaohua layer, reservoir parameters are calculated respectively.

3.1 Saertu Oil reservoir parameter calculation

3.1.1 the calculation of the porosity for effective Saertu reservoir parameters

According to wireline logging principle, acoustic logging is used to measure the formation of longitudinal wave velocity, mainly reflects the formation of porosity. Density logging is to reflect the formation of bulk density, which can calculate the porosity of the rock. Therefore,it can choose porosity logging acoustic (AC) porosity and density porosity (DEN), two kinds of logging methods, finally choose the best way to determine the correlation between the region as the porosity interpretation model.

Saertu reservoir with coring well data and logging data of 54 layer, porosity calculation method based on data of 54, the correlation coefficient is 0.83, the average absolute error of plus or minus 1.0 (Fig.2).

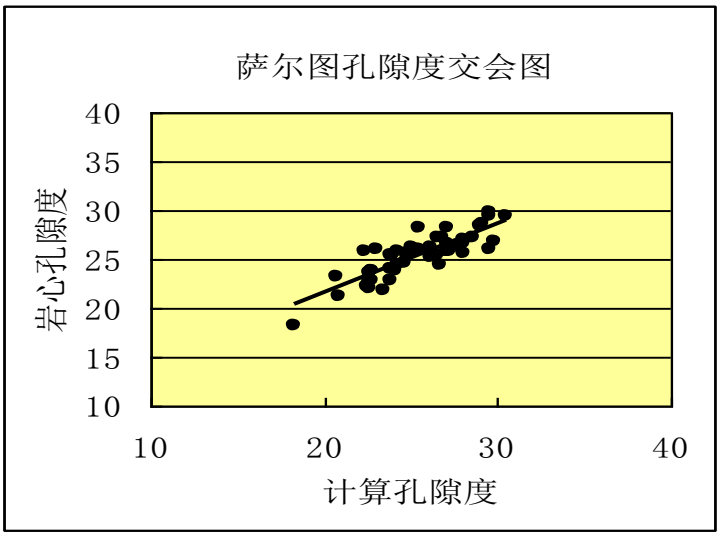

Fig.2 Saertu porosity crossplot

3.1.2 calculation of irreducible water saturation for effective Saertu reservoir parameters

Irreducible water saturation has an important role in reservoir evaluation, which is an important parameter of exploit, but right now there is not an independent evaluation of irreducible water saturation logging method, the description of the relationship between the irreducible water saturation and the logging parameters are based on core and logging data statistical analysis, the relevant conclusions according to the experiment.Therefore, we use the block core analysis porosity and irreducible water saturation 43 layer data, using multiple regression mathematical method to calculate irreducible water saturation of reservoir;Irreducible water saturation calculation method based on data of 43 layer, the correlation coefficient is 0.82, the average relative error was 13.8% (Fig.3)

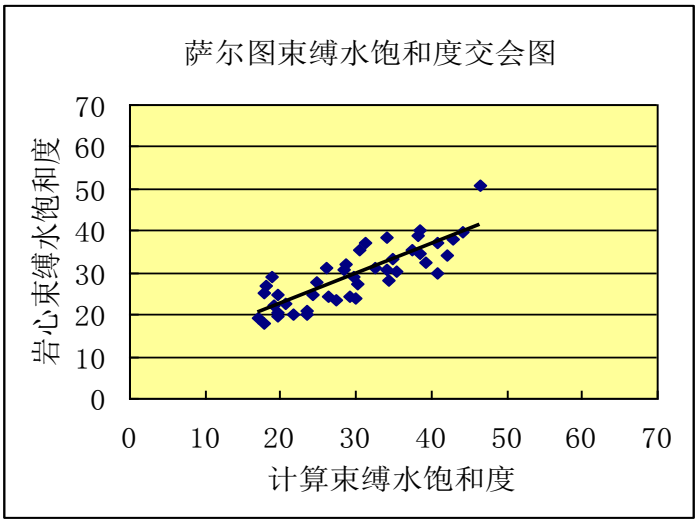

Fig.3 Saertu irreducible water saturation crossplot

3.1.3 effective Saertu reservoir permeability parameter calculation

Permeability is the main factor to determine whether formation can exploit fluid, it can be used the multiple regression method to establish the permeability and irreducible water saturation, porosity calculation method.

Permeability calculation data of 44 layer by using the correlation coefficient is 0.92, the average relative error was 39.8% (Fig.4).

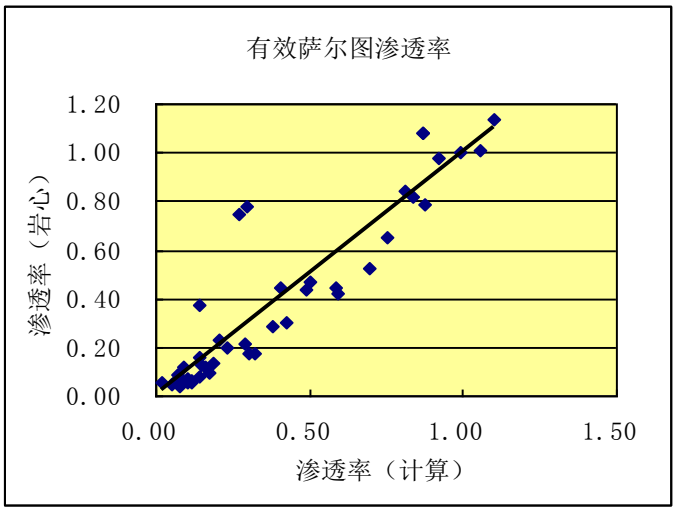

Fig.4 Saertu effective permeability

3.1.4 thickness of Putaohua oil layer effective reservoir porosity parameters calculation

Calculation of porosity method using 116 data, the correlation coefficient is 0.82, the average absolute error is 0.8 mm.

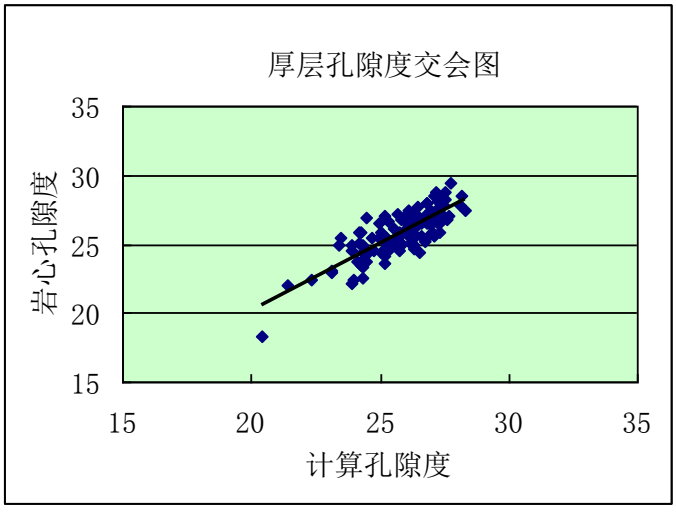

Fig.5 Thick layer porosity crossplot

3.1.5 Putaohua reservoir effective thickness reservoir group of irreducible water saturation parameters calculation

Irreducible water saturation calculation method using the data from the 113 - correlation coefficient of 0. 86, the average relative error was 12.4%.

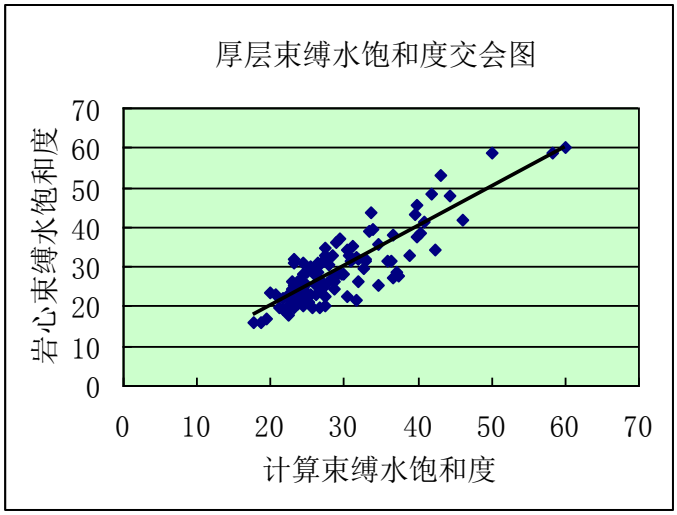

Fig.6 Thick layer irreducible water saturation crossplot

3.1.6 Effective putaohua reservoir group of thick oil reservoir permeability parameters calculation

Permeability calculation method for the data of 116 layers by using the correlation coefficient is 0.96, the average relative error was 32.5%.

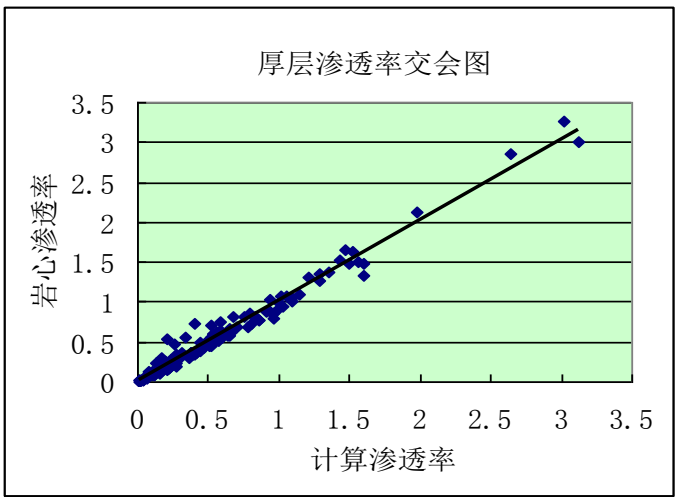

Fig.7 Thick layer Permeability crossplot

3.2 Effective Saertu, putaohua oil layer thick reservoir water saturation parameters calculation

The block water injection development for a long time, due to the heterogeneity of formation, inland water flooded layer is not uniform, some upper layer water flooded, and some lower watered-out layer, and the middle layer water channeling, water injection type complex, great changes at the same time, the physical properties of the rock, which makes the response characteristics of water flooded layer is very complex.Using the theory of archie model, combining with the logging data to calculate water saturation.

Sw = F (a, b, m, n, Rw, Rt, Φ)

A and b – constant m - pore bond index

n - saturation index Rw -formation water resistivity

Rt - deep lateral resistivity Φ - porosity

This model is used to calculate water saturation mean absolute error of plus or minus 9.4% (Fig. 8).

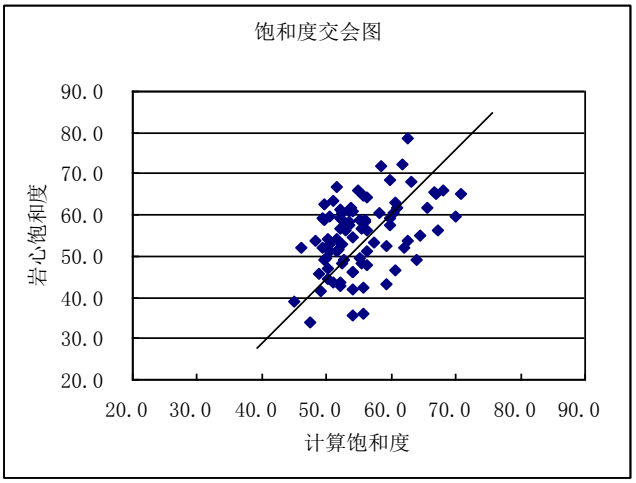

Fig.8 Saturation crossplot

Ⅳ. APPLICATION EFFECT EVALUATION

To apply the reservoir parameter calculation method mentioned above to explain Xingnan oilfield well X logging curve, quantitative calculation of porosity and irreducible water saturation, permeability, water saturation at present. Compare the calculation results with those of the coring analysis data, the porosity of the average relative error is plus or minus 1.4%;the average relative error of permeability is plus or minus 67.4%; irreducible water saturation goes to average relative error of 15.8%; the water saturation average relative error is 17.6%.

Well	layer	Porosity (average relative error)	Permeability (average relative error)	irreducible water saturation Average relative error	water saturation (Average relative error)
Xing X Well	27	1.4	67.4%	17.6%	15.8%

Ⅴ. CONCLUSION AND UNDERSTANDING

Xingnan oilfield development zone water flooded layer reservoir parameters is calculated by subsidizing reservoir group, porosity, permeability and irreducible water saturation which has significant improvement of accuracy.Calculation results can provide support for oilfield development, fine geologic description with accurate data basis.

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