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Establishment of a Well Logging Curves Normalization in Daqingzi Oilfield

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Abstract: - After environmental correction, logging data still has the system deviation caused by different logging tools' calibration between logging suites and the factors of manipulate. In order to reduce the effect of not-geological factor to the logging data, according to the characteristics of the area, mainly using tendency surface analysis method, the correction method of combined with frequency of distribution histogram method and mean correction method as auxiliary to standard the logging data(taking sonic logging curve for example) of Putaohua Reservoir in the north of Jilin Daqingzi oilfield. Compared with the physical property of coring wells before and after the correction, the combined correction method can provide accurate basic data for log interpretation which is more suitable for the studied area than using either the frequency of distribution histogram method or the tendency surface method alone.

Keywords: *- well logging normalization; tendency surface analysis method; frequency of distribution histogram; combined correction method*

I. INTRODUCTION

In the process of exploration and development of oil fields, to ensure that all logging data using the same instrument calibration standards and agreed is very difficult. So the logging data we get there will be influence from geological factors and non-geological factors. The purpose of standardization is to eliminate the influence of geological factors and retention of non-geological factors. Standardized are divided into qualitative and quantitative methods. The former mainly includes frequency histogram, mean correction method and curves overlap method. The latter is mainly tendency surface analysis method. On the basis of previous studies, using tendency surface analysis alone can not eliminate human and logging series error well. By adopting a tendency surface analysis based method, the correction method of combined with frequency of distribution histogram method and mean correction method as auxiliary to standard the logging data to eliminate non-geological factors (log scale and operator error) on the logging data.

II. SELECTION OF KEY WELLS AND THE MARKER BED

2.1 selection of key wells

key wells selection must have four conditions. First, evenly distributed in the work area; Second, coring data and laboratory analysis information are more complete; Third, located in favorable locations structure and better quality borehole; Fourth, log response characteristics significantly which facilitate the region's tracing contrast [1]. Through the core data and logging data analysis of the study area, despite the work area exists lots of logging suite types, but the 3700 as a series-based logging and in the region has a relatively uniform distribution. So we choose 3700 logging suite wells as key wells.

2.2 selection of the marker bed

Standard layer refers to the impermeable reservoir that basic cover the whole area, thicker, single lithology and electrical characteristics significantly, which is generally subject to the following conditions:

1) From the target interval closer;
2) Non-permeable reservoirs affected by oil and gas and porosity and other relatively minor, such as anhydrite,

dense or relatively pure limestone shale;

3) Changes in lithology little, contains fewer impurities;

4) Stable distribution in the work area, 90% of the work area's well point are displayed [2].

After comprehensive comparative and analysis of the purpose of the study interval , selecting the stabilizing shale of the bottom section of Yao 2 + 3 as a standard interval with a thickness of about 10 m.

III. THE METHOD OF WELL LOGGING CURVES NORMALIZATION

3.1 Tendency surface analysis method

3.1.1 The principle of tendency surface analysis method

Any geological variable z's observations zi and observation point coordinates xi, yi constitute a point in a three-dimensional space, referred to as Mi (xi, yi) . Tendency surface analysis method is under conditions which Mi is known, according to a principle fitting a continuous mathematical surfaces, in order to study geological variables on a statistical analysis of the regional and local scale changes in laws.

3.1.2 The determination of times of fitting tendency surface

The determination of times of fitting trend function related to the accuracy and reasonableness of using tendency surface analysis method to standardize well logging curves. The level of fitting responses how much the total information that tendency surface has, but it can not judge the tendency surface analysis as the sole criterion for effectiveness. Typically, the fitting will be fitted with the increasing number increases, when the fitting times reach a certain value, the fitting will be fitted with an increase in the number gradually reduced. Fitting and fitting times has a sine curve relationship, so fitting at the apex of the sinusoidal frequency is the best frequency [3].

Through the tendency surface method and the combined method has different fitting times, we found that when fitting times to four times, fitting reaches the highest point (Table 1). And the fitting of the combined method has a 6% higher than tendency surface analysis method at this time. Visible combined method is more suitable for the block.

times of fitting	fitting degree of tendency surface correction	fitting degree of mean correction method	fitting degree of the combined correction method
1	0.2678	0.2965	0.3356
2	0.3426	0.3798	0.3965
3	0.4529	0.4856	0.5012
4	0.5769	0.6102	0.6359
5	0.5103	0.5426	0.5648
6	0.4956	0.5123	0.5314
7	0.4126	0.4369	0.4536

Table1 The Comparison Table of Goodness for Fitting for Different Degree of a Trend Surface

3.2 Frequency of distribution histogram method

Frequency of distribution histogram method is to divide the value of different wells of the standard layer into several sections, namely statistic the frequency of the number of each well falls in each segment, as well draw a histogram for each frequency, and comparing the logging value of the standard layer of key wells as a method which remained unchanged according to the frequency histogram peak of standard layer to take the

frequency of distribution histogram of key wells as a criterion, then calculation and analysis of the curve values for all wells corrected to unity scale range [4].

3.3 Mean correction method

Mean correction method principle obtained key wells (by core data scale) and corresponding to each response averages of other wells of standard layer. The difference between the average response of standard level for each well and each key well at the same mean as a well logging response standardized correction amount [5].

After directly correcting by the tendency surface analysis method we found significant residuals outliers. Through analysis the logging data, we found that these outliers are mostly due to human factors, so the use of the average correction method in this article for residuals individual outliers should be done first to reject it before the use of tendency surface analysis. And then take the difference value between average of logging responses around the well point and the unusual point as the well-point correction, in order to reduce the impact of human factors.

3.4 The combined correction method

By analyzing the data of the study area, we found that the area due to the large area affected by a certain structure of standard layer. If using the frequency histogram method to correct, it will eliminate the non-geological factors as well as the useful geological factors to us. So we use tendency surface analysis method to be correct. But on the block directly into the standardization tendency surface analysis, residuals curves obtained a certain amount of outliers. Some of these outliers showed a certain distribution, and others had no regular distribution. Through analysis we learned that a regular distribution of these outliers should primarily impact by logging suite. And those outliers with no regular distribution are caused by human factors. In order to eliminate the influence of these outliers to normalization. On the work area adopting a tendency surface analysis based method, the correction method of combined with frequency of distribution histogram method and mean correction method as auxiliary to standard the sonic logging curves.

For work area specific circumstances using combined correction method to correct. Concrete processes: first of all, do tendency surface analysis to all sonic logging curves to get corrected residuals. Then we can analyze residuals. If the residuals outliers showing the distribution regularity, we have statistics on these wells, in order to eliminate the effects of logging series in a small area. For the individual outliers, mean correction method is adopted to eliminate the impact of human factors. After these two correction methods, we corrected the data for tendency surface analysis again to get residuals. If the exception of data still exists, we analyze the data for anomalies then repeat the job before. Finally get the value corrected by logging suite correction and outlier correction. In all of the work area wells that have sonic logging curves using the tendency surface analysis to standard.

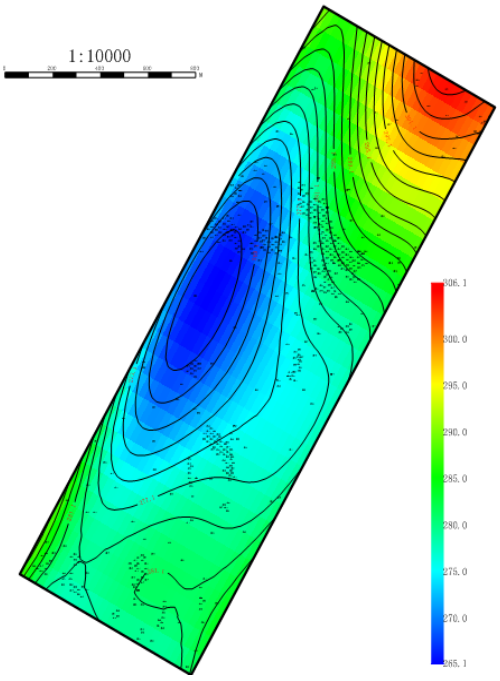

Fig.1 The Trend Map after Trend Surface Analysis

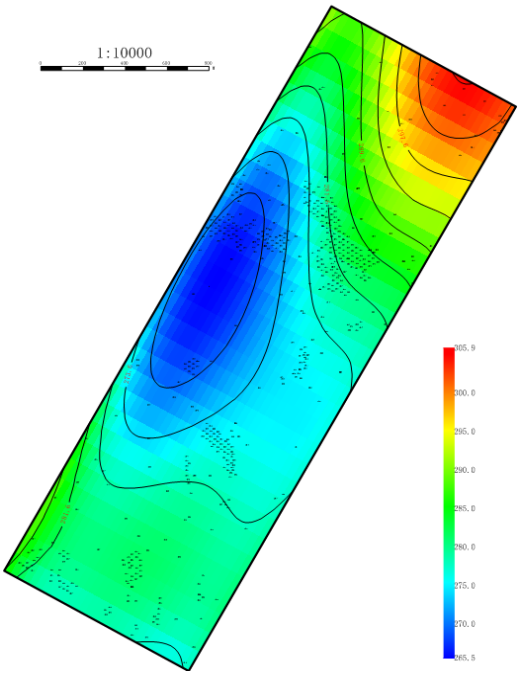

Fig.2 The Trend Map after The Combined Method

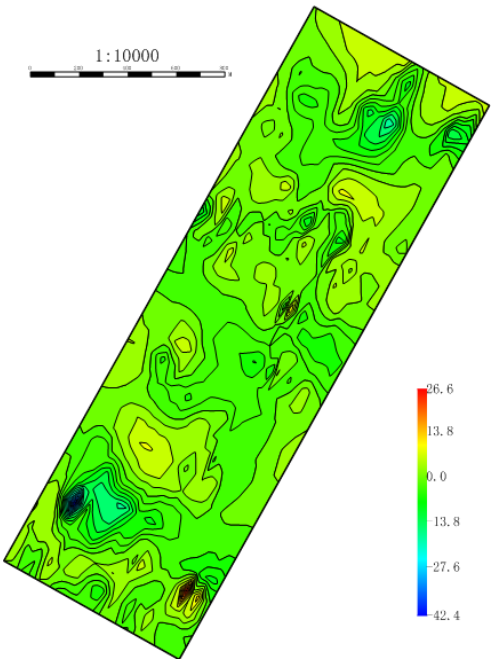

Fig.3 The Trend Surface Residual Trend Surface Analysis

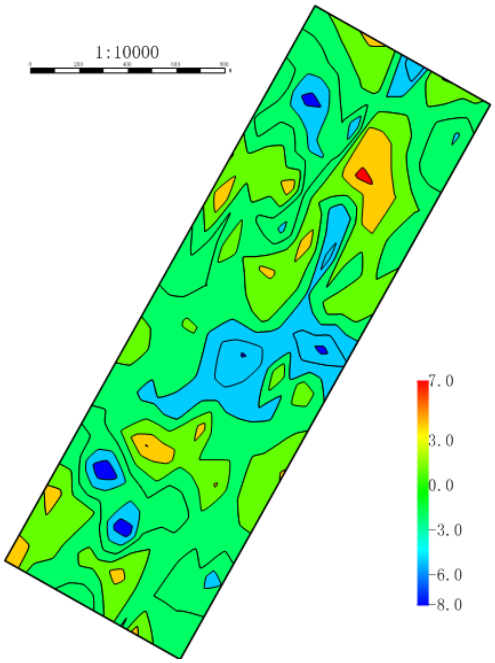

Fig.4 The Trend Surface Residual after The Combined Method

By correction we find that the tendency surface combined method after the correction trend surface analysis diagram to get a more direct view of tendency effect（Figure 1,2,3,4）. Using the combined method of correcting residual plots amplitude difference is 15 and the direct application of tendency surface analysis after standardized residuals amplitude difference is 68. The magnitude of the difference between the residual reach 4-fold. This proves that the application of a comprehensive law to standardize the correction to get better results.

IV. THE EFFECT OF VERIFICATION

Applications combined correction method to standardize corrected all sonic logging curves .Physical properties were explained by the curve before and after correction, and with the interpretation of the physical properties and core analysis of physical properties (in porosity for example) were compared (Figure 5). From the figure we can see, the physical properties explained by a combined method of standardization have a better correlation with core analysis than before. Porosity average error of ± 3.1% from the original down to ± 0.8%, accuracy is increased by nearly four times.

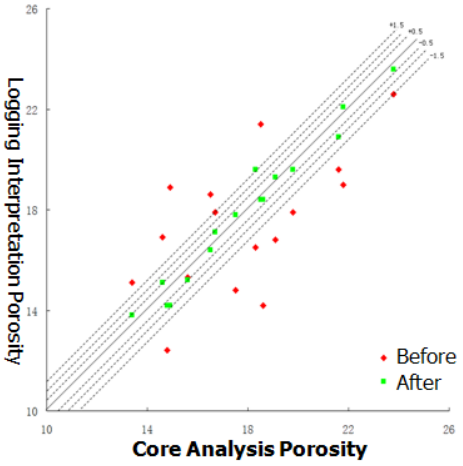

Fig.5 The Comparison Chart of Porosity

V. CONCLUSION

1) In the tendency surface analysis, adding logging suite of correction will help improve the accuracy of tendency analysis. To increase logging comprehensive interpretation makes sense.

2) Standardization always relative, normalized value is only further approximation of the true value, but not equal to the true value. Integrated use quantitative and qualitative of standardized, allows us to be more close to the real value.

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