Interpretation and evaluation of the electrical thickness of 0.2m high-resolution logging series

Li Xiuqin

No.1 Oil Production Company of Daqing Oilfield Company Ltd., Daqing Heilongjiang 163001, China Sartu District, Daqing City, Heilongjiang Province.
13009826212
54434345@qq.com

Abstract-This article compares and evaluates the electrical thickness interpretation results of the 0.2 m high-resolution logging series and the currently applied DLSII logging series. The author finds that there is no difference in their external thickness electrical measurement interpretations. However, the interpretation thickness and number of layers of the high-resolution logging series with an effective thickness of 0.2 m have increased slightly, and the oil layer group Gaotaizi, which is mainly thin and poor layers, has increased. This conclusion laid a foundation for the promotion and application of the 0.2m high-resolution logging series.

1. Introduction
On the basis of the DLSII logging series, the logging company has improved the density, natural gamma, spontaneous potential and three-lateral logging tools to improve the longitudinal resolution of the logging series. The 0.2 m high-resolution logging series is integrated from the vertical resolution of the 0.2 m logging.

In 2015, we conducted a comparative evaluation of the interpretation results of the 0.2 m high-resolution logging series and the DLSII logging series on eight wells out of the ten wells in Block A. There are problems with the 0.2 m spontaneous potential curve in some intervals of the remaining two wells, so we did not evaluate the thickness interpretation results.

2. Classification Standard of sandstone and off-table thickness
The microsphere ratio and high-resolution Acoustic time difference are used as the criteria for choosing different thicknesses, and the high-resolution acoustic time difference is used as the criteria for judging high resistivity layers. The effective thickness of microsphere is less than the effective thickness criterion, but is larger than the off-table one (sandstone) criterion, and the effective thickness of microsphere is less than the effective thickness criterion, the effective thickness can still be divided when the density is less than 2.2 g/cm3. When the density curve is not good enough, the effective thickness is zoned, not enough is not zoned. For Thin interbeds with sufficient layering, the upper peak value can be reduced by 0.5 ~ 2.0. "M. ". For undivided layer bottom drag slope is not standard with the bottom third of the natural potential amplitude control, less than one third of the layer off-table thickness, one third of the layer off-table thickness.

In principle, each reservoir in an oil field can only be divided into off-sheet thickness if it simultaneously meets all the electrical criteria for off-sheet thickness, except for the following cases: First, when dividing off-sheet thickness, when the time difference between the microsphere and the
sound wave is sufficient, at the same time, the off-table thickness can be divided if the existing microelectrode amplitude difference and the natural potential have negative anomalies, the microelectrode curve is high value bayonet type, no amplitude difference or very small positive or negative amplitude difference, the high resolution depth trilateral and microsphere curve is high value bayonet type, the acoustic time difference curve is high value, and the density curve is low value, it can be divided into effective thickness when well diameter and natural gamma-ray curve are normal and identified as high-pressure abnormal layer Fourthly, for the special wells with low baseline value of integral curve in a section, the data of adjacent wells should be referred to for comprehensive interpretation.

2.1. layering principle
The delamination was determined according to the return degree of micropotential and the thickness of interlayer. When the interlayer thickness is less than 0.4 m, the extra-table thickness is also divided into layers at the interface of small layer and oil bottom. The delamination is determined according to the degree of return of high-resolution deep three-lateral curve. When the high-resolution deep trilateration apparent resistivity returns ≥10%, the layer is stratified (see Fig. 1), and the first peak at the top of the thin interbed (more than three peaks), the high-resolution deep trilateration apparent resistivity curve is stratified (see Fig. 2). The bottom gradient layer, under the condition of layering (B/A ≥10%) , adopts its own small thickness value when the small spike of the gradient part is more than 10% (see figure 3) ; when the small spike of the gradient part is less than 10% or is shown as a step, use a large thickness value (see figure 4, figure 5) for the gradient part of the protuberance or step value. Under the condition of no layering (B/A ≤10%), the small peaks or steps of the gradient are of large thickness and read themselves. If the resistivity of the main layer is greater than or equal to the standard, and the resistivity of the graded layer is slightly lower than the standard (0.5 ~ 1.0 m), the good part of the microelectrode curve can be divided into the effective thickness.

![Figure 1](image1)

**Figure 1** B/A≥10% measured by layers

![Figure 2](image2)

**Figure 2** B/A > 10% measured by layers
2.2. *division principle of sandstone and off-table thickness*

When the return degree of micropotential is more than 30% and the interlayer thickness (low resistance interlayer thickness or high-low resistance interlayer combined thickness) is more than 0.4 m, the off-sheet thickness is expressed separately. When the thickness of the interlayer is less than 0.4 m, the thickness of the attachment layer is equal to or greater than that of the interlayer, and the thickness of the attachment layer is less than that of the interlayer.

2.3. *principle of effective thickness division*

For a more uniform thick oil layer, the sandstone thickness is neither stratified effective thickness nor stratified effective thickness. For Thin interbeds, when the high-resolution deep three-lateral layers are not enough, all the layers are laminated. If the thickness of the appendage is greater than or equal to the thickness of the interlayer, the effective thickness is deducted and the effective thickness is expressed separately if the thickness of the appendage is less than that of the interlayer.
2.4. Thickness measurement
The microsphere curve is taken as the control parameter of measuring the thickness. When the microsphere is standard enough, the control divides the thickness and indicates to the high-resolution deep three-lateral curve. Within this range, the half-amplitude point controls the effective thickness, the bottom third control divides the sandstone, the table outside thickness, the general quantity micro gradient curve half amplitude point. When the micro-gradient curve is not well displayed or two or more peaks of the micro-gradient curve correspond to one peak of the micro-potential curve, the half-amplitude of the micro-potential curve is measured.

3. Comparative evaluation of electrical measurement and interpretation of thickness outside the table
The author analyses the external thickness in the DLS II logging series and the 0.2 m high-resolution logging series in the thickness classification, oil layer classification, off-surface (second-type sandstone) expansion, independent development characteristics, the number of outer-surface thickness layers and the total thickness. The thickness interpretation results (Table 1) show that there is no difference between the two electrical thickness interpretation results.

### Table 1  Statistic table of the results explained by electrical thickness measurement outside the table

| statistical mode           | classification     | Electrical interpretation results |
|----------------------------|--------------------|----------------------------------|
|                            |                    | 0.2 m high-resolution logging    | DLS II logging series          |
| thickness classification (m) | <0.5               | 87.8                             | 87.8                           |
|                            | 0.5-1.0            | 173.8                            | 173.8                          |
|                            | 1.0-2.0            | 256.6                            | 256.6                          |
|                            | ≥2.0               | 525.1                            | 525.1                          |
| oil layer classification (m) | oil layer group a  | 328.5                            | 328.5                          |
|                            | oil layer group b  | 285.1                            | 285.1                          |
|                            | oil layer group c  | 429.7                            | 429.7                          |
| development type (m)       | external expansion | 172.0                            | 172.0                          |
|                            | independence       | 85.7                             | 85.7                           |
| Total number of layers (pieces) |                    | 899.0                            | 899.0                          |
| Total number of thickness (m) |                    | 1043.3                           | 1043.3                          |

4. Comparative evaluation of effective thickness electrical measurement interpretation
The author analyses the effective thickness in the DLS II logging series and the 0.2 m high-resolution logging series in terms of thickness classification, oil layer classification, effective thickness layers, total thickness, effective thickness inter-layer number and inter-layer thickness total. The thickness interpretation results (Table 2) show that there is little difference between the electrical thickness interpretation results of the two series. Details are as follows:

### Table 2  Statistical analysis of effective thickness electrical thickness measurement interpretation.

| statistical mode           | classification     | Electrical interpretation results |
|----------------------------|--------------------|----------------------------------|
|                            |                    | 0.2m high-resolution logging     | DLS II logging series          |
| thickness classification (m) | <0.5               | 87.6                             | 83.2                           |
|                            | 0.5-1.0            | 79.3                             | 77.9                           |
|                            |                    | difference value (0.2m-DLS II)   |                                 |
|                            |                    | 4.4                              | 1.4                            |
Compared with the DLSII logging series, the electrical thickness interpretation of the 0.2 m high-resolution logging series has an increase of 8.3 m in the total effective thickness and 19 layers in the total number of layers.

Evaluation result: In the high-resolution logging series with an effective thickness of 0.2 m, a single well has an average increase of 2.4 layers and the thickness has increased by 1.0 m.

It is mentioned in the interpretation standard of the 0.2 m high-resolution logging series electrical thickness that when the micro-spheres are not enough for the effective thickness standard but greater than the standard of the off-surface type (sandstone), the effective thickness can be used for secondary discrimination. Effective thickness can also be divided when it is equal to 2.2 g/cm³ (oil layer group a) and the high-resolution density value is less than or equal to 2.22 g/cm³ (oil layer groups b and c), so the electrical thickness is increased to 8.3 m. The DLSII logging series interpretation standard mentions that when the effective thickness is less than 2.2 g/cm³, the effective thickness can be divided.

For example, in Well E, oil layer group c I8-9 (depth of 1116.1 m) (Figure 6) has a micro-sphere value of 13 ohm-meter, which does not meet the effective thickness standard (in the interpretation standard, when the micro-sphere value reaches 13.9 ohm-meter, the effective thickness can only be classified in meters), but it is greater than the off-table standard (in the interpretation standard, the thickness of the sandstone can be classified when the micro-sphere value reaches 10.8 ohm-meter), so we can use the effective thickness for the second judgment. The density value of the DLSII logging series is 2.22 g/cm³. According to the standard, the effective thickness of this value still cannot be classified as the effective thickness after the second discrimination; but the high-resolution density value of the 0.2 m high-resolution logging series is 2.15 g/cm³, which can be judged twice based on the effective thickness, and the effective thickness is 0.3 m.

Compared with the DLSII logging series, the electrical thickness interpretation of the 0.2 m high-resolution logging series has an increase of 8.3 m in the total effective thickness and 19 layers in the total number of layers.

Evaluation result: In the high-resolution logging series with an effective thickness of 0.2 m, a single well has an average increase of 2.4 layers and the thickness has increased by 1.0 m.

It is mentioned in the interpretation standard of the 0.2 m high-resolution logging series electrical thickness that when the micro-spheres are not enough for the effective thickness standard but greater than the standard of the off-surface type (sandstone), the effective thickness can be used for secondary discrimination. Effective thickness can also be divided when it is equal to 2.2 g/cm³ (oil layer group a) and the high-resolution density value is less than or equal to 2.22 g/cm³ (oil layer groups b and c), so the electrical thickness is increased to 8.3 m. The DLSII logging series interpretation standard mentions that when the effective thickness is less than 2.2 g/cm³, the effective thickness can be divided.

For example, in Well E, oil layer group c I8-9 (depth of 1116.1 m) (Figure 6) has a micro-sphere value of 13 ohm-meter, which does not meet the effective thickness standard (in the interpretation standard, when the micro-sphere value reaches 13.9 ohm-meter, the effective thickness can only be classified in meters), but it is greater than the off-table standard (in the interpretation standard, the thickness of the sandstone can be classified when the micro-sphere value reaches 10.8 ohm-meter), so we can use the effective thickness for the second judgment. The density value of the DLSII logging series is 2.22 g/cm³. According to the standard, the effective thickness of this value still cannot be classified as the effective thickness after the second discrimination; but the high-resolution density value of the 0.2 m high-resolution logging series is 2.15 g/cm³, which can be judged twice based on the effective thickness, and the effective thickness is 0.3 m.
In the same way, the value of the micro-spheres of oil layer group II16 (depth of 1196.3 m) in Well F(Figure 7) is 12 ohm-meter, which is not enough for the effective thickness standard (in the interpretation standard, only when the micro-sphere value reaches 16 ohm-meter, effective thickness can be divided), but greater than the off-table standard (in the interpretation standard, the thickness of the sandstone can be divided when the micro-sphere value reaches 11 ohm-meter), we can use the effective thickness for secondary discrimination. The density value of the DLSⅡ logging series is 2.25 g/cm³. According to the standard, the effective thickness cannot be classified as the effective thickness after the second discrimination; the high-resolution density value of the 0.2 m high-resolution logging series is close to 2.21 g/cm³, which is effective according to the standard. The second discrimination of thickness can complement the effective thickness of 0.4 m.

Figure 7 Curve characteristics of oil layer group c II 16 in Well F

The classification of different thicknesses (4 levels) shows that the electrical thickness interpretation of the 0.2 m high-resolution logging series is 4.4 m more than that of the DLSII series, accounting for 53% of the increase in thickness, that is, the thickness interpretation of the effective thickness less than 0.5 m has a larger difference; the effective thickness is greater than or equal to 0.5 m and less than 1.0 m, and the effective thickness is greater than or equal to 1.0 m and less than 2.0m, which are 1.4 m and 1.8 m respectively, which are relatively small; the effective thickness greater than or equal to 2.0 m explains the difference of 0.7 m, which is the smallest.

Evaluation result: The increased thickness of the 0.2 m high-resolution logging series is mainly due to the thin layer.

In terms of different oil layers, the electrical thickness interpretation of the 0.2 m high-resolution logging series is 7.4 m more than that of the DLSII series, accounting for 89% of the increase in thickness, that is, the effective thickness oil layer group c has a relatively large difference in thickness interpretation; for oil layer b, the group thickness interpretation differs by 0.8 m, the difference is small; there is no difference in the thickness interpretation of oil layer group a.

Evaluation result: The 0.2 m high-resolution logging series mainly increases the thickness in the oil layer group c.

In terms of the effective thickness of the internal inter-layer, the effective thickness of the adjustment well has little difference between the electrical thickness interpretation results of them. There are 8 more inter-layers in the 0.2 m high-resolution logging series than the DLSII logging series, which is 1.2 m longer.

Evaluation result: The average single well in the effective thickness of 0.2 m high-resolution logging series increases by one inter-layer, and the thickness of the inter-layer increases slightly.
For example, if we use DLSⅡ logging series interpretation standard, it cannot be classified as effective thickness; but if we use 0.2 m high resolution logging series interpretation standard, then it can be divided into effective thickness. We can use the buckle inter-layer standard to buckle the inter-layer with a thickness of 0.1 m, and then increase an effective thickness of 0.4 m.

![Figure 8 Curve characteristics of oil layer group c111 in Well G](image)

5. Conclusions
(1) In terms of surface thickness, the 0.2 m high-resolution logging series and the DLSⅡ logging series have the same electrical thickness interpretation results.
(2) The effective thickness of 0.2 m high-resolution logging series of electrical thickness interpretation layers and thicknesses are mainly the thin and poor layers of the oil layer group c.
(3) The evaluation of the 0.2 m high-resolution logging series electrical thickness interpretation has laid the foundation for its promotion and application.

References
[1] Lv Jing. Operation Regulations of New Logging Series in Daqing Placanticline on Effective Thickness, Thin-Poor Layer I and II Divided by Electrical Property, 1999.
[2] Ning Likai, Pei Zhansong, etc. Study on Method of Completion of Logging Interpretation Parameters, International Field Exploration and Development Conference (IFEDC), 2018.
[3] Yu Yalou. User Manual for Single Well Treatment Interpretation System, 2001.
[4] Zhang Yunying. Research on the Method of Stratified Value of Logging Curves, 2003.