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Study on the Method of Logging Evaluation in Middle Rank Coal Bed Methane Reservoir

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1 Introduction

With the increasing demand and the lack of natural gas in China, the unconventional gas is urgently needed as the substitute of the conventional natural gas which is explored more difficult. Coal bed methane is the most possible substitute of the conventional natural gas for the reason that our country is rich in coal resource and CBM (CBM is short for coal bed methane) resource is very rich in China. In the exploration and development of CBM, Geophysical logging is an important method to recognize rock stratum, analyze coal characteristic and evaluate CBM reservoirs. The existing state of CBM is different from conventional gas for the coal reservoir has the double porosity structure of the matrix pores and the fracture pores, and the content of CMB is also influenced by many factors, such as coal quality, coal rank, ash content. So the evaluation method of the geophysical log of CBM is different from that of conventional natural gas. Taking the Jixi basin as an example, this paper discusses the method of logging evaluation in middle rank coal reservoir from experimental data of coal rock and conventional logging data.

2 Log Data Preprocessing

2.1 Depth correction of logging curve

The logging curve depth corrected by core data is to ensure the response depth of log curve is consistent with the depth of formation. Well JQ1 is chose as a standard well. Find the depth of coring formation in standard well remembered as Y_{01}, Y_{02}….. $Y_{0n,}$ and find the formation in the rest of logging curves which is same with the coring formation in standard well and record the depth as Y_{11}, Y_{12}, …, Y_{1n}, Y_{21}, Y_{22}, …, Y_{2n}, ……, Y_{n1}, Y_{n2}, …, Y_{nn}, Because the depth of the log is consistent with the depth of the core, so the depth correction coefficient "K" of each coring formation can be obtained in turn.

$$K=\sum\frac{\Delta Y}{n}$$

The corrected depth:

$$Y^{'}_{x,i} = Y_{x,i} + K$$

In the formula: K- Depth correction factor; x- the x-th well; i: i-th core layer.

2.2 Standardization of logging curve

The logging curve is standardized as follows: Using the logging data of the key well in standard layer to make histogram, and it's used as the scale of standardization of logging date; Analyzing the frequency distribution of logging data in each standard layer, contrasting it with the standard mode one by one, and checking the accuracy of the well logging data.

3 Coal Seam Recognition and Thickness Determination

Coal seam in the study area of Jixi basin is widely distributed, but the thickness is relatively small, generally between 0.5m-3m. Coal seam is identified through clustering analysis and Curve amplitude superimposition, and a high precision identification plate is made for the thin coal seam whose thickness is less than 1.5m.

3.1 System clustering analysis

After core homing and standardization of logging curves, principal factor of all logging curves is analyzed by eliminating the logging data of coal reservoirs whose correlation coefficient is less than 0.5 and taking the eigenvalues whose cumulative contribution rate have reached 90%. Then the principal component is clustered as follows: Selecting 3 in the classification number "m"; stripping the result of clustering analysis one by one;

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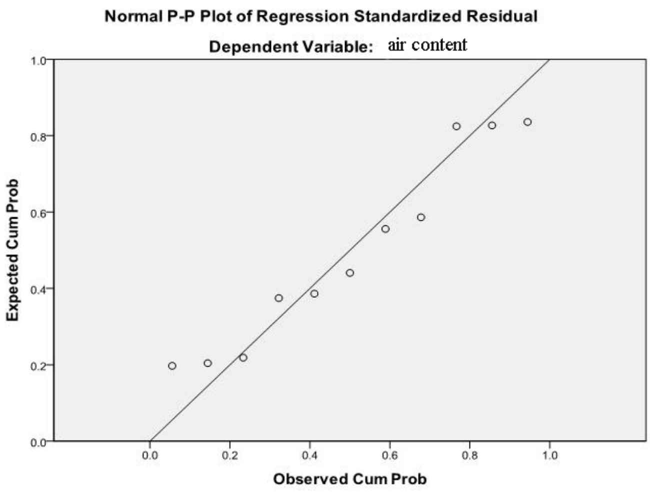

Fig.1 Analysis of correlation between measured and calculated values

referencing curve feature at the same time; identifying coal seam and determining the thickness.

3.2 Relative amplitude superposition

The response features of coring coal seam in the study area are low gamma, low density, high acoustic wave, and high resistivity. New relative amplitude superposition curve "CB" is obtained by calculating the difference between the original curve and average value of each log curve (△AC, △Rt, △GR, △DEN) and fitting logging data.

$$CB=\Delta AC/10+\Delta Rt/100-\Delta GR/10-\Delta DEN/10 \quad (1)$$

Though core calibration results and the analysis of

$$Aad = d + e * DEN + f * \left(\frac{GR}{100}\right)^3 \quad (2)$$

Cross-plot, coal seam identification standard is determined when the CB curve reached 10, the coal seam thickness is considered as the 3/5 of formation thickness whose amplitude is bigger than 10.

4 CBM Content Determination

Relations coefficient between logging parameters and gas content is obtained by using coring analysis data to calibrate log data and factor analysis though statistical analysis software SPSS. The results show that gas content is negatively correlated with sonic velocity and density, and it's positively correlated with resistivity. The Relationship between ash and natural gamma, neutron density is fit though the application of the custom curve. Then the formula is obtained though the custom curve fit by logging data and ash. The correlation between the measured value and the calculated value reached 0.85 (Fig.1).

Fitting formula of ash content and DEN, GR:

The relationship between CBM content and Mad (water), Rt (resistivity), Fcad (fixed carbon), AC (acoustic

$$F(x) = 2*\ln[a*\frac{Mad}{RD} + b*\frac{Fcad}{AC} - c*\frac{Aad}{AC}] \quad (3)$$

time), Aad (ash).

In the formula: The a, b, c, d, e, f are unknown coefficients determined by regional stratigraphic features.

5 Conclusion

The method of cluster analysis can be used to identify sensitive logging parameters of coal reservoirs, and it's conducive to the identification of coal reservoirs. The method of relative amplitude superposition can highlight he display features of logging data in the coal seam, and it's a better method for identifying thinner reservoirs less than 0.5m. CBM content in study area is calculated by calibrating coring analysis data to fit logging data and fitting to obtain the relationship between CBM content and logging curve.

References

Jiang Huaiyou, Zhao Wenzhi, Zhang Dongxiao, et al, 2008. The Research on World Natural Gas Resources and Exploration Status[J]. Natural Gas Industry, 28(7):12-16.

Zhao Qingbo, Liu Bing, Yao Chao, 1998. Status of Coalbed Methane Industry Development in the world[M]. In: Beijing. (ed.), Geological Press.

Wang Xinmin, Fu Changsheng, 1998. Examples of Foreign Coalbed Methane Exploration and Development[M]. In Beijing. Petroleum Industry Press.

Qian Kai, Zhao Qingbo, 1995. Theory of Coal bed methane exploration and development[M]. In Beijing. Petroleum Industry Press.

Zhao Qingbo, LiWuzhong, Sun Fenjin, 1997.Distribution and Accumulation Regularity for Coalbed Methane in China[J]. Acta Petrolei Sinica, 18(4):1-6.