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Joint Hydrodynamic Sectioning Method and Logs for Determining Mud Shale Organic Carbon Content

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Summary

As the organic carbon content directly influences the optimization of shale gas exploration zones, an in-depth evaluation on organic carbon content is particularly important. At present, the most common method for determining the organic carbon content in the mud shale is the ΔlogR method, which is lose sight of the hydrodynamic conditions and sedimentation environment, such as underwater disturbance and oxygen content difference, the difference in preservation conditions for organic matters. Those can lead to in great variation in the organic carbon content. This paper introduces the evaluation technique for the organic carbon content in the mud shale.

Introduction

As the organic carbon content directly influences the optimization of shale gas exploration zones, an in-depth evaluation on organic carbon content is particularly important. At present, the most common method for determining the organic carbon content in the mud shale is the △ logR method, which do not take the hydrodynamic conditions and sedimentation environment into consideration, such as the underwater disturbance and oxygen content difference, the difference in preservation conditions for organic matters. Those can lead to great variation in organic carbon content. This paper introduces the evaluation technique for organic carbon content in mud shale.

TOC Calculation Method

Hydrodynamic conditions division: Shale reservoir TOC distribution is influenced by hydrodynamic conditions. According to the Hydrodynamic strength combined with core and logging data analysis, shale reservoirs can be divided into three types: Massive block of shale with strong hydrodynamic force, weak laminated shale section of the transition hydrodynamic zone, laminated mudstone segments of weak hydrodynamic bands.

TOC interpretation model creation: According to the reservoir hydrodynamic subsection situation，combining with the test data of TOC core and log data, the logging response characteristics of TOC is analyzed, and the relationship between the reservoir segment logging curve (such as GR, Rt and DT) and TOC is discovered, which is used for multiple regression analysis. Finally, the whole well segment TOC calculation model is created.

TOC Calculation Result

In M well, the reservoir segment is divided into block, laminar and weakly laminated shale sections according to different hydrodynamic conditions, and then the content of TOC is calculated by using this method. Figure 1 (a), (b) and (c) correspond to three hydrodynamic conditions. From figure 1, it can be seen that the TOC which obtained in this method have a good correlation, indicating that the calculation of the TOC result is highly reliable, which is close to the organic carbon content of the original formation. Figure 2 shows the comparison of the results of the triangle logR method and this method. As can be seen from the figure, the calculation accuracy of the method is significantly improved.

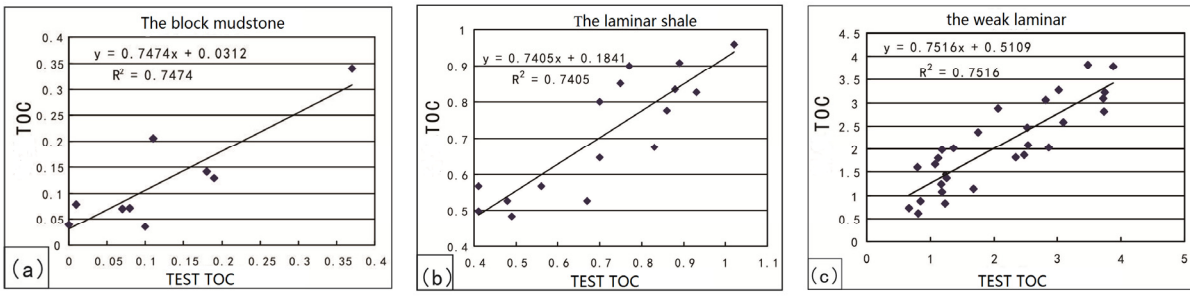

Figure 1 *TOC correlation analysis chart.*

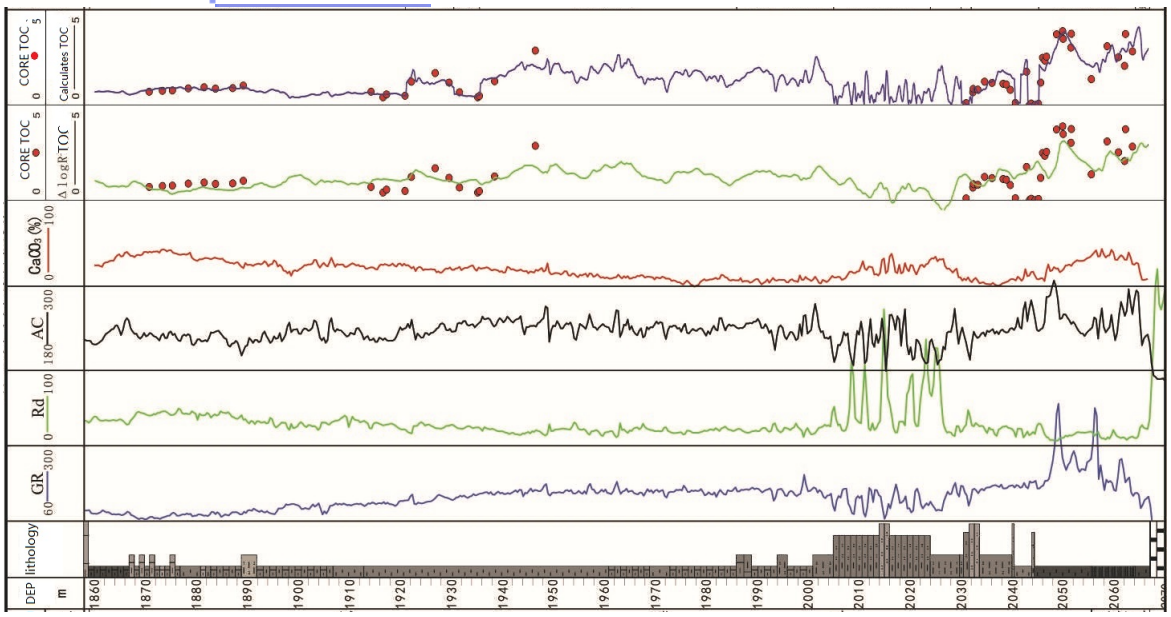

Figure 2 *The comparison of the results of this calculation method and* Δ *logR.*

Conclusions

Through analyzing the hydrodynamic shale sedimentation cause of formation, and using the hydrodynamic sectioning method, this paper carries out a multivariate regression analysis with the logging curves of natural gamma, electrical resistivity, interval transit time as a result of response to the TOC sensitivity, summarizes the relations among logR, AC/GR, 1/GR and TOC and works out the data of organic carbon content along the whole well section. This technique takes the mud shale formation and the occurrence characteristics of its organic matters into consideration, and avoided the serious error resulting from the same formula off different lithologies. Actually, it has achieved desirable results in prediction of organic carbon content in the marine shale in south Sichuan Basin in south China.

References

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