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Effective source rock distribution prediction of the first member of Qingshankou Formation (k_1qn_1) in Shengping-Weixing region

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Abstract: The identification of effective source rocks is the basis for the study of oil and gas accumulation in sedimentary basins,and its distribution has important control effect on oil and gas accumulation.Combined with the hydrocarbon generation characteristics, analysis of the hydrogen index of hydrocarbon source rocks (HI), hydrocarbon index (TI) and the content of TOC, think about theTOC mass fraction of hydrocarbon source rocks with significant contribution to the formation of oil and gas reservoirs was more than 2% in Daqing oilfieldShengping-Weixing region, and the hydrocarbon expulsion depth was 1680m. Prediction of TOC content in single well by well logging Δlog Rmethod， and using the TOC content lower limit value as the evaluation standard to further determine the different thickness of the effective hydrocarbon source rocks of Wells and plane distribution characteristics. Results show that the two main development effective hydrocarbon source rocks, strong for hydrocarbon source rocks in southern, northern for weak hydrocarbon source rocks.

Key word: *Effective hydrocarbon source rock; hydrocarbon expulsion characteristics; TOC content lower limit value*

I. EFFECTIVE HYDROCARBON SOURCE ROCK DISTRIBUTION PREDICTION

1、The lower limit of the effective hydrocarbon source rock

The geochemical lower limit of effective hydrocarbon source rocks mainly consists of two aspects， on the one hand, the lower limit of organic matter abundance, usually with the total organic carbon content (TOC) evaluation， based on organic matter maturity, on the other hand, determine the lower limit evolution degree, can be achieved by evolution of hydrogen index (HI), hydrocarbon index (TI)[1].

II. ORGANIC MATTER ABUNDANCE

Statistical results of the content of total organic carbon (TOC) and hydrogen index (HI) show that the $k_1qn_1$hydrocarbon source rocks have universal rule,the hydrogen index (HI) and total organic carbon content (TOC) has a good relationship.In the low mature stage, the HI increased with the increase of TOC,TOC greater than 2% after HI stable at around 600mg/gTOC, does not continue to increase with the increase of TOC. It shows that the high abundance hydrocarbon source rock of TOC is greater than 2%, the unit organic carbon content of hydrocarbon generation potentialwas the same, to achieve the highest, therefore, TOC greater than 2% can be used as the lower limit of organic matter abundance of effective hydrocarbon source rocks (Fig. 1).

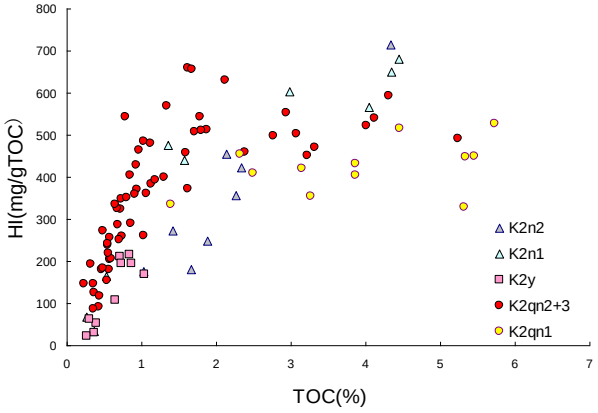

Fig. 1 the relationship between organic carbon content and hydrogen index in the source rocks in the northern part of Songliao Basin

(2) Evolution degree lower limit

Pepper (1990199 c) think that at the stage ofoil generation or gas generation the adsorption hydrocarbon quantity can take a fixed value, which can simplify the hydrocarbon expulsion model of hydrocarbon source rocks. Residual hydrocarbon according to formation using a fixed average value (S2 / TOC), because the average value can accurately reflect the average expulsion of hydrocarbon source rock condition[2]. After statistical pyrolysis data of Shengping area, the average quantity of residual hydrocarbon was 70mgHC/TOC.

Select Fang 122, Fang 16, l 6, L 9,Tai 7, Tai 6 wells (TOC > 2%) 11 wells, production HI and TI relationship diagram, it was concluded that the immature stage (< 1590m), HI did not decrease, and the TI was not increased;Hydrocarbon generation but have no hydrocarbon expulsion stage (1600 ~ 1680 m),HI did not reduce, but TI has significantly increased, source rock cheese roots have been generated asphalt, but no obvious expulsion of hydrocarbons;A large number of hydrocarbon expulsion phase (> 1680m), HI reduction, TI is greater than 70mg/gTOC.SO it was determined that the hydrocarbon expulsion threshold is 1680m.

III. SINGLE WELL HYDROCARBON SOURCE ROCK EVALUATION

(1) Evaluation model of single well logging for hydrocarbon source rock

Because the source rock has obvious heterogeneity, and the geochemical evaluation parameter distribution is limited, and the log data is continuous distributionin vertical direction, so it is necessary to evaluate the hydrocarbon source rock.Organic carbon in rock can lead to many kinds of logging response. However, due to the complexity of the underground situation, almost every kind of logging response is the result of a variety of geological factors, and not just the result of organic carbon response[4], it is necessary to combine many kinds of logging information to calculate the organic carbon content in source rocks. From a variety of logging information, first of all need to extract effective parameters, the organic carbon content of the instruction and then build a quantitative relationship between the organic carbon content and the logging parameters,that selects theΔlog Rmodel with sonic moveout and resistivity parameter(figure 2).

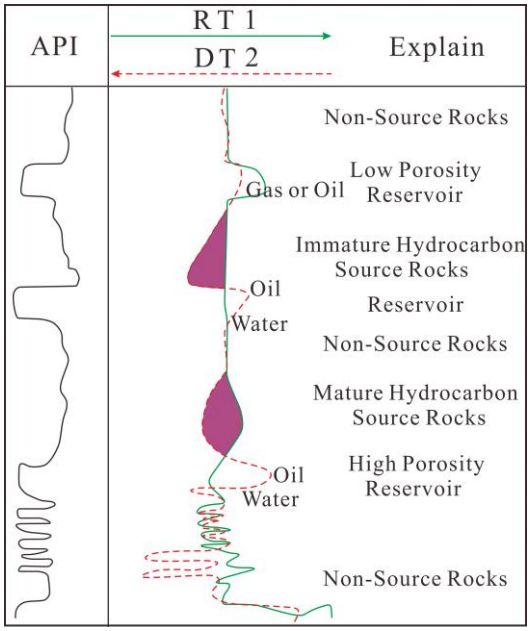

Figure 2 logging evaluation model of hydrocarbon source rocks

Δlog R model derivation and experiments and application to the world successfully by the oil company EXXON/ESSO. The techniques to advance the composite coefficient of a given arithmetic coordinates of acoustic moveout and composite arithmetic under the logarithmic resistivity curve, by determining the baseline position, calculating Δ log R distribution, to establish a quantitative interpretation of organic carbon content.The technique uses the pre specified overlap coefficient to overlap acoustic time difference in arithmetic coordinates and resistivity curve in the arithmetic logarithmic coordinate, by determining the baseline position, calculating Δ log R distribution, to establish a quantitative interpretation of organic carbon content[3].

According to the acoustic wave and the resistivity superposition calculateΔlog Requation.

ΔlogR= log(R/Rbaseline)+K(Δt-Δtbaseline) （1）

Type:ΔlogRis the distance between the two curves; R is well logging instrument measured resistivity (omega m); R baseline is corresponding to the baseline(Ω.m) resistivity;Δt is measured acoustic transit time (μs /ft); Δtbaseline is corresponding to the baseline interval transit time (μs/ft).K=0.02, for the time difference of the sound wave and the resistivity of the superposition coefficient. ΔlogR is linearly related to organic carbon, and is a function of maturity. The empirical formula for the calculation of organic carbon by Δlog R is:

$$\mathrm{TOC} = \Delta\mathrm{logR} \times 10^{(2.297-0.1688LOM)} + \Delta TOC \quad (2)$$

Type:TOC is the calculation of the organic carbon content (%); LOM represents the maturity of organic matter, TOC is the organic carbon content of the background value， need to be determined.The advantages of this method for acoustic time difference and resistivity composite can partly eliminate the influence of porosity logging response to organic carbon.

By adjusting the AC and RD about the limit of single well,make the two logging curve coincide in the stable development of non-hydrocarbon source rock, at the stage of hydrocarbon source rock development, the difference caused by the high AC anomaly and the high RD anomaly have a good positive correlation with the TOC, such as M1 well correlation calculation results R^2 = 0.7243, it illustrate theΔlog R method is used to calculate hydrocarbon source rock organic matter abundance, and choose the M1 well for the reference well has the high degree of credibility.

(2) Standardization of well logging curve

The logging curve can indirectly reflect the lithological information of the underground.However, in practical work, due to the influence of mud, caliper and instrument and other measuring factors, the logging curve needs to be pretreated to eliminate the influence of non-geological factors.The main purpose of the standardization of logging curve is to eliminate or reduce the system error, so that the log data can reflect the geological characteristics.Therefore, we selected 72 wells in work area, and calibrate the AC and RD curve of these wells.

(3) The TOC logging evaluation results

Using the principle of hydrocarbon source rock evaluation, 27 wells are selected as typical representative.By calculating the dark mudstones organic matter abundance make associated well profiles to determine the high organic matter abundance mature hydrocarbon source rocks in the area of vertical distribution characteristics.From the vertical point of view (Figure 3),the abundance of organic matter appeared three positive cycles in turn from the bottom to the top of the first member of Qingshankou Formation, then there is a small part of the stable low value segment, upward transition to a longer positive cycle. And it can be seen from the horizontal and vertical associated well profiles, the thickness of source rock is larger in the southeast direction. Through this area 27 wells the evaluation results, the statistics of each well TOC > 2% of the thickness of dark mudstone(associated well profilesof the yellow filling section), as a constraint for effective hydrocarbon source rocks plane distribution prediction.

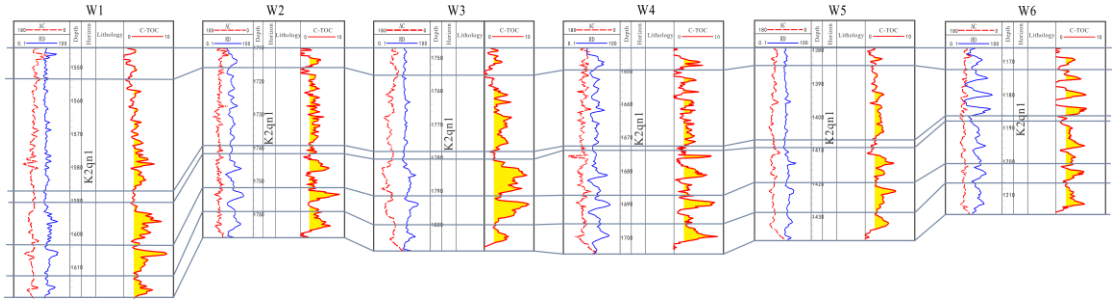

Figure 3 Well log evaluation of hydrocarbon source rock associated well profile in Shengping

IV. DISTRIBUTION OF EFFECTIVE HYDROCARBON SOURCE

(1) The standard of effective hydrocarbon source determination

The standard of effective hydrocarbon source range on plane includes two aspects， On the one hand, according to the regional geological background, known well， conjectured effective thickness of source rocks that TOC＞2%in this areaon the basis of the trend of the $k_1qn_1$formation thickness, On the other hand, according to the HI TI change with depth relationships determine hydrocarbon expulsion depth of 1680 m.

(2) Distribution of effective hydrocarbon source focal in this area

According to the above standard, firstly,we identified two effective sourcesof the first member of Qingshankou formation (k_1qn_1) in Shengping-Weixing region, that is, the weak source of hydrocarbon in the northern and the strong source of hydrocarbon in the south.From the distribution of the hydrocarbon source and the distribution of the proven oil reservoir (Fig. 4), we can know the oil and gas have been found be mainly controlled by the strong source of hydrocarbon in the southern, the weak source range of the northern also has a certain scale, which is the favorable exploration direction in the next step.

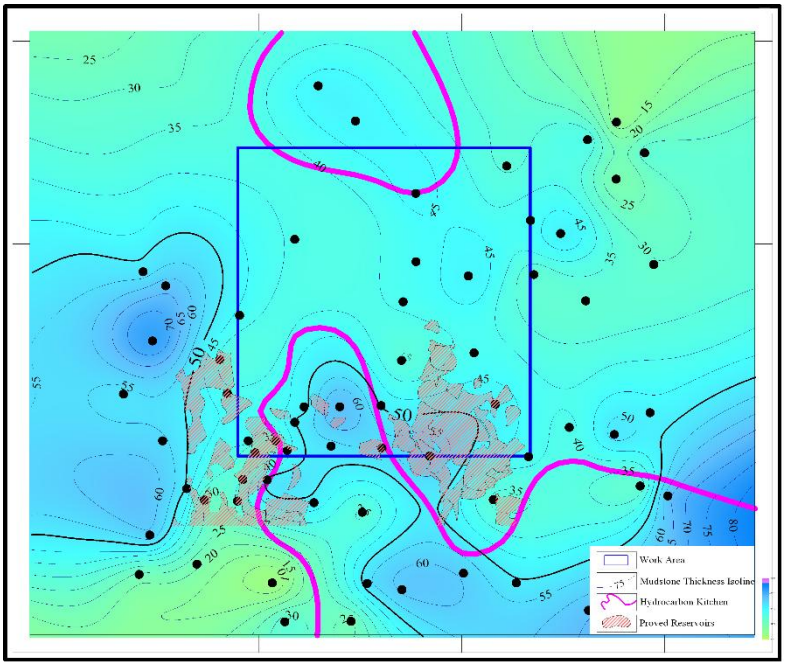

Fig. 4 Distribution of effective source in Shengping

V. CONCLUSION

Compared with the method of determining the lower limit of TOC content in the past, through analyzedthe relationshipbetween the dark mudstone content of TOC and pyrolysis parameters of hydrogen index (HI), and hydrocarbon index (TI) to determine lower limit of hydrocarbon expulsion of hydrocarbon source rocks was more superiority.It not only considers the hydrocarbon generation characteristics of source rocks, but also considers the characteristics of hydrocarbon expulsion from source rocks.Using this method to determine the lower limit of the effective hydrocarbon source rock TOC mass fraction is 2%. The main hydrocarbon source rock in Shengping area mainly developed in the south, at the same time, the weak source rocks in the northern also have certain scale are the favorable direction for the exploration.

REFERENCE

[1] Gang Wenzhe, Wu Yue, Gao Gang, et al. Geochemical features and geologic significances ofsource rocks in Nanpu Sag, Bohai Bay Basin [J]. Petroleum Geology and Experiment, 2012, 34(1).

[2] Wang Peng, Liu Guangdi, Cao Zhe, et al. Identification of effective source rocks of Lower Cretaceous and its controlling on hydrocarbon accumulation in Chagan Depression. Lithologic Reservoirs, 2015, 27(2).

[3] Zhang Yan, Wang Pujun, Chen Wenli, et al. Identification and Mapping of the Effective Source Rocks-Take the Kongquehe Area of the Tarim Basin as an Example. Journal of Jilin University (Earth Science Edition), 2007, 37(3).

[4] Wang Zhihong, Luo Xia, Li Jingkun. Effective Source Rock Forecasting in Deep Layers of Northern Songliao Basin, 2008,19(2).