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Rock Geochemical Pyrolysis and Gas Chromatography Technology Application in Judging Oil and Water Layer

Shen Jianian, YU Deyi, Cui Jia, Feng Jun
Northeast Petroleum University, Heilongjiang Province163318, China

***Corresponding Author:**
Shen Jianian
Email: 540612018@qq.com

Abstract: In view of the peripheral "three low" oil fields of daqing have a poor reservoir lithology property, complex oil-water distribution, and only by log data can't meet the needs of the fluid identification, application of geochemical pyrolysis and gas chromatography analysis technology, judging oil and water layers. The application results show that the technology can well solve the problem of complex oil-water distribution area of low permeability oilfield fluid identification. The peripheral oil fields of undeveloped blocks in drilling and perforation scheme establishment has a certain guiding value.

Keywords: Sidewall coring, Geochemical pyrolysis, Gas chromatography, The residual carbon.

INTRODUCTION

Rock geochemical pyrolysis analysis, gas chromatography analysis, get the underground oil and gas information directly[1],Only with the reservoir contains organic abundance of hydrocarbon and hydrocarbon mass fraction of each component in the related, the reservoir lithology, formation water property,physical properties are relatively small, is to find one of the important means of oil and gas reservoir directly.Domestic only will the technology used in the exploration areas[2],and there is no quantitative interpretation[3].Along with the advancement of exploration and development integration mode, daqing oil field development evaluation block by micro amplitude structure, the influence of factors such as fault, lithology, the oil and water distribution is more complex, the original the deep lateral and self-potential curve is adopted to poor thin oil and water layer and water layer high resistance and low resistance oil layer interpretation precision is low, only by log data cannot meet the needs of the fluid identification[4].To effectively improve the oilfield development, the use of the geochemical pyrolysis and gas chromatography technology judging oil and water layer, guide the drilling rig Run don't plan and prepare well. From the application effect of the technology and oil field actual match degree is higher, has good application prospect.

BASIC PRINCIPLES

Rock geochemical pyrolysis

In particular pyrolysis furnace temperature programmed opposite, the hydrocarbon and kerogen in rock under different temperature and cracking, by the carrier gas purge with sample physical separation, and quantitative detection by the carrier gas to carry into the detector, the hydrocarbon quantity into electrical signals, after computer processing, liquid hydrocarbon and cracking hydrocarbon content in the samples, according to the quantitative evaluation, reservoir parameters.

Residual carbon

Thermal conductivity detector is oil and gas shows evaluation instrument equipment and its analysis principle is the samples under 600℃ after pyrolysis combustion to 6 min, the samples of the remaining CO_2 is the transformation of organic carbon and a small amount of CO;CO after CuO catalytic conversion of CO_2, in the condition of 60℃ collection CO_2[4]; In the condition of 250℃ high temperature all have adsorption of CO_2, by the thermal conductivity detector, converted to residual carbon content.

Gas chromatography

After dealing with the cold cut rock sample chromatographic analysis or direct thermal evaporation for chromatographic analysis[5]. Samples of hydrocarbons under the carrier gas to carry into the chromatographic column, components in the mobile phase and stationary phase distribution of the two phases to repeatedly.Due to the adsorption of components or fixed dissolving ability is different, so the speed of chromatographic column of components is different, after a certain long column, separated from each other, order leave chromatographic column into the detector, the ion current signal after amplification by a computer automatically record the chromatographic peak of components and their relative content.According to the chromatographic outflow curve characteristics and relative content of each

composition, the qualitative identification of oil and gas layer.

APPLICATION EFFECT

Determine laminar liquid storage

Some poor poroperm property, small thin layer sandstone sedimentary thickness, gas chromatography technology can make an accurate qualitative description of the laminar liquid storage.Reservoir characteristics of the carbon number distribution of a wide range, the main peak, carbon for 13C-30C.Component is complete, the corresponding normal alkanes was pointed comb structure in rules.

Because the water content is relatively low, oxidation and bacteria solution function is weak, so formed not distinguish compounds content is low, the baseline is relatively flat.∑C-21-∑C+22 higher values.Such as aromatic 60-74 well interval is 1536. 2 m, coring 1, brown sandstone oil powder, oil is not full, weak base, oil evenly, good physical properties, geochemical pyrolysis analysis of quality of carbon content in peak S1 to 10.92 mg/g, low peak S2 to 6. 01 mg/g, S1/S2 value of 1.82, reflected in high abundance and oil well.Gas chromatographic analysis of reservoir characteristics, interpreted as reservoir, testing results for industrial oil flow.Water characteristics of the main peak is not obvious, carbon number distribution of 14C-27C, the corresponding normal alkanes was C composition is not complete; distribution is flat to comb or saddle.The baseline did not distinguish compounds content under high and low.Xu 52-58 well interval is 1640.0 m, the carbon number range is wide, low spectral peak normally distributed, under the baseline did not distinguish compounds content high, the oil layer characteristic as shown in figure 1. Oil-water namely peak obvious characteristics of the carbon, carbon number distribution of a wide range of 13C-29C, rules of distribution of the corresponding normal alkanes was in a rush ,unlike pure oil chromatographic flow curve, this kind of reservoir with high water content, water power, water and oil of close contact, and resulting in the crude oil of bacteria solution and oxidation, strong form did not distinguish compounds content high, the baseline show obvious dome shape as shown in figure 2.

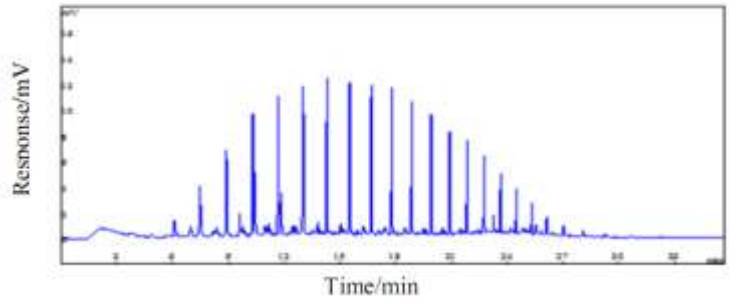

Fig-1: Xu 52-58 well PI 6 layer 1640m oily water features

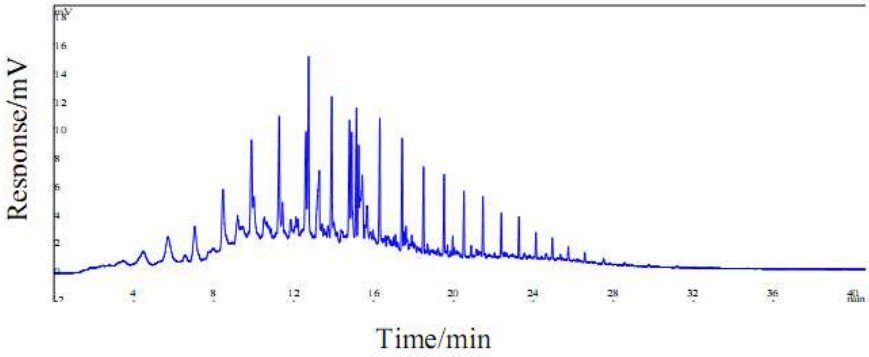

Fig-2: Xu 52-58 well 1600 m oily water features

Qualitative interpretation oil and water layer

Base pyrolysis analysis and gas chromatography analysis data, combined with the sidewall coring physical observation, the preliminary qualitative interpretation standards formulated the Song Fangtun oil-water layer.Song Fangtun oilfield putaohua reservoir interpretation parameters shown. The display is usually oil full, uniform distribution, after correction for pyrolysis total hydrocarbon content of S_T>15mg/g, S_1/S_2>1.5, gas chromatography to form normal triangle, baseline no dome shape, Pr/Ph<1.2, Pr/P_{17}<0.24 and Pr/P_{18}<0.24, ∑C_{21}-∑C_{22}+>1.2 Layer shows general for oily, dry or oily spots crumb distribution, S_T<10mg/g, S_1/S_2<1.2, gas chromatography for low amplitude after triangular form ,baseline clear dome shape, Pr/Ph>1.0, Pr/P_{17}>0.26, Pr/P_{18}>0.24, ∑C_{21}-∑C_{22}+<1.2.Oil-water display tree is commonly oil is not full, uneven distribution, S_T<17mg/g, S_1/S_2<1.5, gas

chromatography to form triangle before or after, baseline dome shape significantly, Pr/Ph>1.0, Pr/P17> 0. 2, Pr/P18>0. 2.

Reservoir oil saturation calculation

Oil saturation of reservoir parameters; typically by the acquisition of reservoir pressure coring well samples sent to lab for fractions for chromatographic analysis have to. This method not only analysis cycle is long, and the drilling cost is high, the drilling cycle is long, thus obtained from laboratory distillation and chromatographic analysis of reservoir oil saturation method has its limitations.Electrical measuring method it can also give oil saturation of reservoir parameter values, but indirect conversion parameters, influencing factors is more, it is difficult to accurately calculate oil saturation of reservoir.

By pyrolysis analysis of basic principle, the parameters of pyrolysis total hydrocarbon content S_T is a quality sample oil gas reservoir, is a form of oil-bearing abundance. If certain porosity, its size and value can reflect the change of oil saturation, the formula is derived for the theory.

$$S_T = So + S_{wi} + S_{or} + 10 \times R_C / 0.9,$$

Type: S_{wi} for the irreducible water saturation; S_{or} for residual oil saturation; R_C for different lithology parameter values. Through mathematical transformation $So = (S_T \times \rho_{岩} \times 10) / (\rho_{油} \times \phi e)$,

Type: $\rho_{岩}$ rock to rock density; $\rho_{油}$ for crude oil density.

Reservoir productivity prediction

Before the test is the purpose of capacity evaluation to evaluate the reservoir production. According to the characteristics of the logging data, puts forward the static capacity evaluation of figure 3 putaohua reservoir productivity evaluation price chart method, on the basis of single well geological reserves evaluation.Single well geological reserves of crude oil, oil bearing area in the unit for a well-controlled by the geological reserves of crude oil of q, namely

$$q = 100 \times H_0 \times \phi e \times So \times R_0 / B,$$

Type: H_0 as effective thickness; R_0 for the gas oil ratio; B for the volume factor.

With oil saturation so as the ordinate, effective porosity and effective thickness H_0 andϕe as the abscissa, the product of putaohua reservoir productivity evaluation chart, set up as shown in figure 3. Can be seen from figure 3, so, the greater the capacity is higher; Effective thickness, the greater the effective porosity, the greater the $H_0 \times \phi e$, the greater the reservoir capacity, the higher the application so -$\phi e \times H_0$ chart, can well distinguish reservoir capacity, try to choose oil layer services.

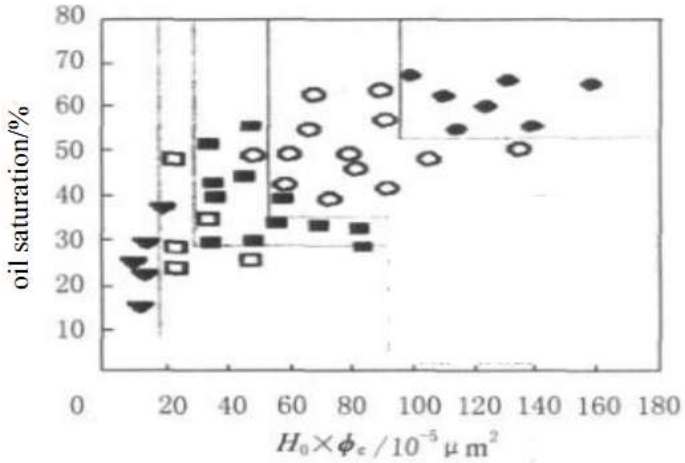

Fig-3: putaohua reservoir productivity evaluation charts

CONCLUSIONS

(1) Pyrolysis analysis, the reservoir S_T best value is greater than 15 mg/g, S_1/S_2 best value is greater than 1.5, and S_T value is less than 10 mg/g, S_1/S_2 value is less than 1.2, generally for the layer.

(2) Gas chromatography analysis showed that the main aquifer with narrow, unimodal, peak after the shape of a triangle or non-normal distribution, baseline drift, high Pr/Ph, Pr/P_{17}> 0.26, Ph/P_{18}> 0. 24, $\sum C_{21}$-$\sum C_{22}$+ low. Reservoir characteristics as the main peak width, peak shape of normal distribution or triangle, baseline straight, high peak, $\sum C_{21}$-$\sum C_{22}$+ high, Pr/P_{17}< 0.24, Ph/P_{18}<0.24,
Pr/Ph is low.

(3) Geochemical pyrolysis analysis and gas chromatography analysis technology, can well identify the complex oil-water distribution area, fluid properties, to a certain extent, to guide the development of undeveloped blocks and drill operation.

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