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Heavy Oil Formation Mechanism Analysis

Ge zhaorong, Jia Mengcheng,
Northeast Petroleum University, Daqing, Heilongjiang, China, 163318

***Corresponding Author:**
Ge zhaorong
Email: 810987302@qq.com

Abstract: Heavy oil as a kind of unconventional oil and gas resources has been the attentions of the geologists at home and in China, bohai bay basin, songliao basin in junggar basin and tarim basin found a lot of heavy heavy oil resources. It is estimated that the heavy oil resources in to be found up to 250×10^8 t, shows the broad prospects for exploration of heavy oil resources. But as a result of water oxidation, bacteria biodegradation, differential migration, high temperature pyrolysis and gas elution effect such as asphalt, oil occur gradually thick, always restricts the development of heavy oil.
Keywords: Heavy oil; Bacteria biodegradation; Oxidation.

THE OIL SOURCE CORRELATION

Oil source correlation between oil and gas with source rock and the contrast between the different reservoir of oil and gas, through comparative study can to clear up oil, gas, oil and gas basin genetic relation between hydrocarbon source rock, oil and gas migration direction and distance and the secondary change of oil and gas. Further selects reliable expected, determine the exploration targets, effectively guide the oil and gas exploration and development [1].

Oil source correlation of the basic methods are: (1) relevant curve method: application, comparison between the normal alkane with relevant curve method. Will select several indicators of oil and source rock of the relative intensity into related curve drawing, can see oil and source rock if there are related. (2) fingerprinting method: the method is simple and intuitive. Just put oil and saturated hydrocarbon chromatogram of possible source rocks, sterane (m/z 217), terpane (m/z 191) the quality of chromatogram fingerprint comparison directly. (3) normalized correlation method: applicable to oil classification, and a lot of contrast between oil and source rocks geochemistry [2].

Different degree of biodegradation of crude oil can be used different methods for oil source correlation [3, 4] (table 1).

Table 1: various degrees of biodegradation of crude oil source correlation method

Degree of biodegradation	Biodegradation of crude oil source correlation method
Slight (1-3)	Meteorological chromatographic fingerprinting method Normal paraffin hydrocarbonsfree carbon isotope correlation method
medium (4-5)	Steroid, terpenoids, biomarker distribution fingerprint correlation method Terpenoids free carbon isotope correlation method
serious (6-7)	High molecular weight (C_{35}) high temperature gas chromatographic fingerprinting method corresponding normal alkanes was developed

Suffer from biodegradable saturated hydrocarbon and aromatic hydrocarbon fractions of crude oil and gas chromatography mass chromatography figure in baseline strong uplift (UCM) bulge, contains a large number of organic compounds and abundant oil and gas geochemical information, can be used in the comparative study on the degradation of heavy oil, by more and more oil and gas to earth the attention of chemists [5].

THE GELLED CRUDE OIL MECHANISM ANALYSIS

With normal oil and gas geochemical research thinks, crude oil, heavy oil properties of determinant are two main types of primary and secondary factors [6-8].

Primary factors is not able to pass the original organic matter properties of thermal evolution into

hydrocarbon, including organic matter types, sedimentary environment and maturity of source materials, they will determine the native oil and gas properties and types. Organic matter types and kerogen types of depositional environment can lead to source materials in produce differences, resulting in different properties of crude oil; The maturity of source materials in different generation have different properties of oil and gas, the higher the organic matter maturity, thermal evolution to generate the lower density of crude oil. Qin Jianzhong [9] also thought the formation of heavy oil and organic matter maturity, kerogen types, sedimentary environment and the organic matter content is closely related to the primary factors. Only low maturity stage, the kerogen type is sapropelic type or partial sapropel type, formed in the sedimentary environment are XianHua - half XianHua basin facies, stable platform depression or lagoon equal closed environment, has certain carbonate content (ω_B > 5%), high abundance of organic matter (ω_{TOC} > 2%) of hydrocarbon source rocks and have generated a large number of native and gather the accumulation potential of heavy oil.

Secondary factors is refers to the hydrocarbon generation, expulsion, migration and accumulation in the process of accumulation and accumulation after the secondary effect of various physical, chemical and biological. Crude oil after the secondary role transformation, the nature will also change in different degrees, and even completely cover up the primary factors. And at the time of the gathered accumulation of oil and gas is always inevitably go through secondary change, therefore, the secondary effect of crude oil on its property is more important than native factors. Among them, the washing effect, oxidation and biodegradation and secondary role is often an important factor of gelled crude oil [10, 11]. In addition, sulfuration, gravitational differentiation, magmatic thermal differentiation, dissipation of lightweight components and evaporation fractionation effect physical action may also cause such as crude oil density increases, higher viscosity, formation of heavy oil. These secondary role often is a kind of give priority to and be integrated with other function role in the formation of crude oil, make its original component damage, such as biodegradation are often accompanied by water washing and oxidation, transform the original oil and gas for heavy oil.

Biodegradation

Biodegradation is refers to the microbial selective consumption of some components of crude oil, crude oil density become larger, viscosity increased [12]. Microbes under the condition of temperature less than 80～100℃ can exist [13], so the biological degradation is a kind of widespread geological process, is one of the important mechanism of thick oil secondary type.

Petroleum geochemistry to biodegradation were discussed from molecular level for oil chemical composition and the effect of a biodegradable research in the field of a branch of the most active and more effective, long-term accumulation of research can not only identify crude oil biodegradation characteristics of symbol compounds, but also for all kinds of biomarker compound resistance to biodegradation ability of discharge sequence, and then applied to the inversion of the biodegradation rate of oil. Heavy oil in order of biomarker compound biodegradation: normal paraffin hydrocarbons, isoamyl diene alkanes, second half mushroom, rules, sterane, rings triterpane, tricyclic terpane, rearrangement sterane, 25-drop hopane, 25, 30 -second hopane, $C_{24}H_{42}$ sihuan terpane, 17α(H)-22,29,30-three drop hopane (Tm), gammacerane (5 a six-member ring carbon skeleton). Biodegradation ability of polycyclic aromatic hydrocarbons in order is: triaromatic steroid series > flexor series > phenanthrene series > naphthalene series. Comprehensive view, the formation of crude oil by biodegradation may be both aerobic and anaerobic microbes the result of joint action. Lift the oil to near the surface of aerobic condition, the crude oil mainly suffer from both aerobic degradation; And in the case of oxygen to the buried depth of oil reservoir is relatively great, the anaerobic degradation may as the leading factor.

Washing effect

Washing effect refers to soluble hydrocarbons in crude oil by unsaturated hydrocarbon formation water selectively dissolved or extraction. And atmospheric connectivity of reservoir with bottom water or edge water through oil-water interface influence on the properties of crude oil, formation water of unsaturated hydrocarbon migration along oil-water interface, selectively absorb and take soluble hydrocarbon, crude oil washing and thickening, and density. As the windy city area in junggar basin Jurassic qi ancient group of heavy 43 Wells-13 Wells of heavy oil around. Actually, just washed effect will normally only partially soluble in water in the crude oil light component, so that the mild thickening of crude oil, but the impact on the composition of crude oil is not big. Therefore, the role of a single water washing on oil thickening effect is not obvious. Washing effect at the time of the gelled crude oil and formation water in marks fade in chemistry. Xiang Caifu [14] according to overpressure transition zone depth range, and in combination with formation water chemical characteristics, marking out better washing effect in the western slope belt of songliao basin in the plane distribution; Think in the region of formation water salinity is less than 5000 mg/L area mainly washing effect, at the same time accompanied by biological degradation and oxidation, and other area of the main causes of formation of heavy oil is not washed.

Oxidation

Oxidation is refers to the formation of oxygen free hydrocarbon oxidation in the crude oil into acid, alcohol, phenol, ketones oxygen-containing organic matter such as a secondary effect of. To reduce crude oil saturated hydrocarbon, hydrocarbon - relative asphaltene content increased, so that the density and viscosity of crude oil increased, become heavy oil. Antioxidant, oxidation to reservoir sedimentary basin in the endogenous antioxidant is limited, such as sulfate, etc. Carried by exogenous oxidants are mainly varies with the atmospheric precipitation infiltration of trace oxygen. The content of dissolved oxygen in water is mainly depends on the strength or groundwater recharge groundwater flow conditions, generally appear in the active region of groundwater, namely there is a connection between precipitation and groundwater. Can usually by formation water salinity, concentration of oxygen containing compounds in water to estimate the thickening of heavy oil whether have close relationship with oxidation. According to the infrared spectrum of oxygen containing functional groups in the abundance of heavy oil can judge whether the thickening of the heavy oil is associated with oxidation. In addition, you can through the study of gas tracer to the degree of oxidation.

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