Study on Formation Conditions and Distribution Characteristics of Deep Oil and Gas Reservoirs Based on Computer Software Analysis

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Abstract. Conventional reservoirs can be formed in the layers with relatively high quality reservoir sections, while unconventional reservoirs such as tight reservoirs can be formed in tight layers. This paper systematically studies and analyzes the formation conditions and distribution characteristics of deep oil and gas reservoirs by using the software analysis ability of computer. Oil and gas reservoir is the basic unit of oil and gas accumulation in the earth's crust. A reservoir exists in an independent trap, in which oil and gas have a certain distribution law and a unified pressure system. Through the computer-aided understanding and calculation of the formation and distribution of oil and gas reservoirs, energy can be found more effectively, which helps to expand the national energy reserves [1].

Keywords: Computer Software Analysis, Deep Reservoir, Forming Conditions

1. Exploration
Through the analysis of computer software, the basin has a dual basement composed of Precambrian crystalline basement and pre Carboniferous folded basement. The sedimentary strata in the south of the basin are generally thicker than those in the north. The basin experienced Hercynian, Indosinian, Yanshanian and Himalayan tectonic movements [2]. In the middle of the formation, it is composed of sandstone and mudstone interbedded in the early stage of formation. In the late stage of basin evolution, a set of sandstone and mudstone formations with coarse-grained glutenite at the bottom gradually becoming finer upward were formed from bottom to top under the background of transgressive system tract. Through the computer-aided model, it is known that Tazhong area is a complicated petroleum system in the basin. The Cambrian gypsum shale, middle upper Ordovician marl and Carboniferous undercompaction mudstone are regional caprocks of Cambrian, lower Ordovician and Carboniferous respectively. Based on the recovery of denudation amount of strata in Tazhong well, fault development history and folding intensity of main seismic sections, it is preliminarily considered that the structural changes at the end of Silurian, Devonian and Cretaceous are the most important to the oil and gas damage in the study area. The amount of hydrocarbon discharged from source rock, effective hydrocarbon migration and destroyed hydrocarbon amount in each tectonic movement are studied by computer-aided method. There are two peak periods of exhalation in Cambrian source rocks, one is the sedimentary development period of Ordovician strata,
the other is the tertiary to present period. The amount of hydrocarbon destroyed by structural change is controlled by three factors: the intensity of structural change, the effective hydrocarbon migration amount before the structural change and the plasticity or sealing ability of the first set of regional caprock above the target layer. It increases with the increase of the intensity of structural change, the increase of effective hydrocarbon migration amount and the deterioration of regional caprock plasticity. The study of the effective oil and gas transportation capacity of source rocks and the sealing capacity of caprocks, the geological and mathematical models for predicting the amount of hydrocarbon destroyed by multiple structural changes. The Tazhong area of the basin experienced three large tectonic changes at the end of Silurian, Devonian and Cretaceous, which destroyed natural resources (2.5x1012m2, accounting for about 25%, 60% and 15% respectively) (Figure 1) [3].

![Figure 1](image_url) Exploration of oil and gas reservoirs.

2. Formation

2.1. Formed by the polymerization of hydrocarbons
The computer-aided demonstration shows that oil is formed by chemical reaction of inorganic carbon and hydrogen under high temperature and high pressure in the deep crust. In the laboratory, simple carbon and hydrogen compounds can be synthesized into petroleum by inorganic synthesis. In addition, hydrocarbons are also found in gases and lava flows emitted by volcanoes, and hydrocarbons are also found in many organisms. The original organic materials are buried in certain environment and conditions. Under certain depth, temperature and other appropriate conditions, they go through the stages of Biochemistry, thermal catalysis, thermal cracking, high temperature metamorphism and so on, and are gradually transformed into oil and natural gas. Oil and gas reservoirs include oil deposits and natural gas deposits. Petroleum is the lower plants and animals (collectively referred to as plankton) in the ocean, isolated from the air and under the action of bacteria (Biochemistry), first form "sapropel", then under the action of high temperature (200 °C) and high pressure (geochemistry), it forms the intermediate product - crude asphalt, and finally forms oil. The formation of natural gas is the "by-product" of oil, which can coexist with oil or exist independently. Through the synthetic evolution of computer, we can know that the formation time span of oil and gas reservoirs is very large, ranging from the Paleozoic (Cambrian) 600 million years ago to the Cenozoic (quaternary) 1 million years ago. The youngest oil deposits are even stored in alluvium, belonging to the modern geological period, with an age of only 4000 years.

2.2. Multiple sets of deep regional caprocks
Computer data show that with the increase of burial depth, the reservoir porosity decreases obviously due to the strengthening of diagenesis. However, in the deep part, due to the influence of other diagenetic environments, secondary changes often occur to form secondary pores, or fracture and other
reservoir spaces are formed due to local structural stress changes, so as to improve the reservoir materials and form effective reservoirs. In the process of deep burial, the whole deep cap rock becomes more dense, and the ability of plugging hydrocarbon is stronger [4]. The abnormal pressure barrier layer widely developed in the hinterland of the basin also has a plugging effect on deep oil and gas (Figure 2).

2.3. Preservation conditions
Superimposed continuous tight oil and gas reservoirs have the distribution characteristics of superimposition of various target intervals vertically and multiple target intervals compounded into slices on the plane, which are difficult to be explained by buoyancy accumulation mechanism or non buoyancy accumulation mechanism. Therefore, the conclusion of computer analysis is that the compound area is a favorable development and preservation area for the "sweet spot" of superimposed continuous tight oil and gas reservoirs.

![Figure 2. Formation conditions of oil and gas reservoirs.](image)

3. Distribution characteristics

3.1. On the plane, oil and gas reservoirs are mainly distributed along fault zones
The surface degassing density of crude oil is light in the South and heavy in the north and light in the East and heavy in the West. According to the difference of fluid properties, Lungu oil and gas field is divided into four blocks according to the characteristics of Ordovician structure and fluid distribution. In the process of computer software analysis, Shulu sag in the south of Jizhong depression is taken as a representative. The trough is small and narrow, the sedimentary thickness is thin, the stratigraphic sequence is incomplete, and the exploration effect of stratigraphic lithologic reservoir is low. The depression is characterized by a single fault dustpan structure characterized by East fault and West super fault, and the plane shape is long in North and South and narrow in East and West. The glutenite body in the inner slope zone is thick and has good lateral continuity. Under the relatively simple structural background, it can form structural lithologic composite oil and gas reservoir depending on the dual control of lithology and fault [5].

3.2. Sedimentary diagenetic background and evolution control vertical stratification and sectional enrichment of deep oil and gas reservoirs
The craton basin in the lower part of the platform basin is dominated by marine carbonate chemical sedimentary environment, and the formation rock has the characteristics of ultra tight in the early stage. After the depth of 4500 m, the brittle carbonate rock stratum is transformed into high porosity and high permeability reservoir through fracture and weathering karst, forming the distribution area of reformed oil and gas reservoir [6]. However, the upper foreland basin is dominated by continental clastic rocks, with rapid sedimentation rate and insufficient diagenetic compaction. When the burial
depth of high porosity and permeability clastic rock in the early stage of diagenesis is more than 4500 m, the original conventional physical properties are still preserved, forming the conventional reservoir development layer of Silurian and upper clastic rock reservoirs. The northern basin developed continental clastic physical sedimentary environment, but the tectonic environment in this area is more stable than that in the platform basin foreland basin evolution stage, and the sedimentation rate of sediment is slow. It is a typical reservoir development area with strong diagenetic compaction and reduced physical property regularity (Figure 3).

4. Conclusion
The main controlling factors of deep oil and gas accumulation in the basin are different. Through the computer software analysis and control of reservoir characteristics, physical property evolution mechanism and source reservoir contact relationship, the structural pattern and evolution control the horizontal zoning and zonal enrichment of deep oil and gas reservoirs in the study area, and the sedimentary diagenetic background and evolution control the vertical stratification and sectional enrichment of different types of deep reservoirs in the study area. The deep tight gas field also has good exploration prospects. At the same time, the Jurassic coal measures tight sandstone gas resource potential in the hinterland of the basin is huge, which is also a favorable exploration area of the basin.

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