

# The Reservoir Accumulation Characteristics and Main Control Factors in the Slope Area

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## Abstract

With the continuous development of petroleum geology theory of China's continental facies basin, the formation of the "Continental Source Theory", "Oil and Gas Source Control Theory of Depression Basin", "Theory of Multiple Oil and gas Accumulation Belt", provide an effective guidance for oil and gas exploration of continental basin. The theory and method of lithologic reservoir in the slope area adjacent to main source sag are in the process of research. Based on the research of structure, sequence stratigraphy, sedimentary characteristics, hydrocarbon migration and accumulation, oil and gas accumulation pattern in large slope area is established in this paper, which points out main controlling factors of hydrocarbon accumulation in the slope: firstly, sufficient oil supply in oil-rich depression is the material basis for the formation of reservoir in slope area; secondly, stratigraphic pinch-out belt; thirdly, a single and effective trap is key factor for oil and gas accumulation. In combination of the exploration status of Western Slope, a favorable target for the next exploration has been determined.

**Key words:** Slope area; Oil and gas accumulation; Controlling factors; Effective trap

## I. THE RESERVOIR ACCUMULATION CHARACTERISTICS OF THE SLOPE AREA

### A. The Qikou sag

Deposition sedimentation organic matter types in the center of Qikou sag is given priority to II<sub>2</sub>-III<sub>1</sub>, and from north to south to the south of

Qikou-Cheng sea, organic matter type is transition to give priority to with type distribution. Organic matter distribution of oil and gas type and evolution degree control, northwest of Qikou sag in overall performance for the distribution of partial humic type organic matter, the formation of reservoir type is given priority to with natural gas condensate); Central distribution of hybrid organic matter, Qikou sag formed mainly of condensate oil and light oil reservoirs types; Qikou sag is formed of crude oil and immature oil reservoir type. Hydrocarbon accumulation in the slope area has the characteristics of continuous hydrocarbon generation, differential accumulation [1]. Such as a sand and sand three sections of main hydrocarbon source rocks are buried and sustained, mature, and the characteristics of hydrocarbon expulsion. Again three parts such as sand reservoir, its oil and gas homogenous, controlled by generating differential accumulation of oil and gas, high slope structure parts accumulation time early, mainly oil reservoir; low slope structure later part accumulation time, give priority to with gas reservoir. In the north slope of Qikou sag disambiguation region is characterized by the same differential accumulation characteristics.

### B. The west slope in the north of Songliao basin

Songliao basin belongs to large continental type oil and gas basin Mesozoic extend, experienced hot long tensile fracture stage, chasmic stage, depression stage and shrink fold stage four tectonic evolution stage. The west slope area in the north of the basin development process, long-term since cretaceous in regional east pour monoclinic state, the total thickness of strata of about 1000-1500 - m, dip

Angle is small, generally less than 2 °, the overall structure is relatively simple, fracture development [2].

The class structure associated with the NE to normal fault, zonal distribution along the fault zone, the axial is NNE to more, trap located mainly in the footwall of fault. Due to the early growth period of normal fault in the deposition of the nenjiang formation is influenced by regional tectonic stress field, the fault activity again make fault nose structure pattern, MingShui group affected by the regional compressive stress at the end of the nose shape structure [3, 4]. Currently found on the tectonic styles for our new fields of oil and gas.

Chenghai slope is located in the southern margin of Qikou sag in the sea, controlled by the basement, the age of strata are updip slope zone, adjacent to oil source at the same time, makes the slope area has become an important point to oil and gas migration and accumulation area [5]. Through the characteristics of tectonic evolution in the study area, oil source, reservoir characteristics, reservoir caprock, trap type and conducting system basic accumulation elements such as comprehensive analysis, points out that the fault, unconformity surface and sand body, formation hydrocarbon compound guidance system, and put forward the shahejie formation "groove controlled sand, superiority of sand body hide" and guantao "roof control" two kind of new mode, the development of the igneous rock for oil and gas accumulation of the main block.

## **II. HYDROCARBON ACCUMULATION MAIN CONTROLLING FACTORS**

Hydrocarbon accumulation conditions mainly including "life, reservoir, cap, circle, shipment, insurance," such as accumulation elements and their interaction relations, accumulation conditions configuration decided reservoir distribution and accumulation of space and time scale, sorting out oil and gas accumulation conditions for further establish reservoiring pattern, the research on the rules of hydrocarbon accumulation has important significance.

### **A. Conditions of hydrocarbon source rock**

Hydrocarbon source rocks can be divided into four categories: these categories and are defined as follows.

Potential hydrocarbon source rocks, the rock contains a sufficient number of organic matter if thermal maturity will produce and expelled hydrocarbons. Effective hydrocarbon source rocks, the rock contains organic matter and is now in the hydrocarbon generation/hydrocarbon expulsion gathered to form a business. Residues of effective hydrocarbon source rocks: due to the thermal cooling events before they run out of supplies such as uplift and erosion of the organic matter so has stopped effective hydrocarbon source rock and hydrocarbon expulsion. Source rocks: dry due to lack of sufficient organic matter live reached a mature state has run out of its ability to produce and expelled hydrocarbons [6].

To be a source rock, must have three characteristics: the number of organic matter, the quality of the mobile hydrocarbons, thermal maturity. The first two components is the product of sedimentary environment. The third is the product of the structure and tectonic history. The amount of organic matter is usually controlled by the content determination of total organic carbon in the rocks. Quality is determined by the organic matter contained in the type of kerogen [7]. Thermal maturity is often by pyrolysis of vitrinite reflectance and data analysis. The abundance of hydrocarbon source rocks is measured by total organic carbon content in the rock. Analysis of rock TOC commonly used two kinds of technology are: rock pyrolysis TOC and LECO pyrolysis. Conventional log can provide information for evaluating regional abundance.

### **B. Reservoir Conditions**

Yubei in the ordovician carbonate reservoir are mainly controlled by the evolution of Hetianpalaeohigh background, and type of unconformity on karst cave reservoir, its scope is controlled by strong heterogeneity of seam karst cave reservoir, the effective reservoir space is mainly for the solution pores and structural fractures. Yubei area 1 fault belt yingshan group experienced middle

caledonian I curtain and early hercynian two karst. Multiphase karst reservoirs for oil and gas accumulation provides good reservoir space, palaeogeomorphology and fracture reservoir development degree and scale control, Yubei 1 fault zone in the exploration practice indicates that the reservoir relative development zone are favorable oil and gas migration channel and accumulation area, is one of the important controlling factors of hydrocarbon accumulation in the area.

### **C. Trap Conditions**

Trap is the product of many geological factors interact with process. Geological factors of all possible combinations of results is to make a trap is unique. However, in the same basin of trap usually has the similarity with other traps, in different traps in the basin can be divided. The choice of classification depends on the purpose of a person. The ultimate goal of this chapter puts forward the classification of trap is found reservoirs. This chapter discusses the classification of philosophy, and explain how to use classification trap scientific rigour and systematic way, and put forward. The classification of the design scheme is flexible so once found new trap types, concept will also along with the change.

The extent of trap: trap amplitude is determined by the trap boundary to measure potential storage capacity or the size of the circle. Vertical amplitude is trap maximum potential means of hydrocarbons. A meaningful trap classification scheme of reservoir, cap rock and fluid properties must be considered and how the fluid in the closed form together. For range is defined by trap boundary, classification scheme is based on the geometric shape, composition, and the cause of trap boundary.

### **D. Transportation systems**

In the process of oil and gas migration experience all constitute the conducting path network system. Permeability oil and gas migration choice the best and the path of least resistance, the trunk channel can be open fracture, unconformable surface pore and permeability good connectivity, conducting layer and their combination (8, 9). Yubei region the ordovician reservoir oil and gas transportation systems can be

divided into fault, unconformity surface and compound such as three categories: (1) fracture type, deep hydrocarbon source rock fracture of mass migration of oil and gas, especially the longitudinal migration plays an important role, small fault or micro cracks in karst body piercing plays a role of connecting internal slot and communication of different karst body piercing. (2) the unconformity surface, the middle caledonian act I tectonic movement caused by unconformity surface have a certain permeability, can be used as the effective channels for large-scale hydrocarbon migration; (3) complex, fault and unconformity surface cross, superimposed and connected each other, constitute a three-dimensional transportation network, is the composite petroleum system, it makes the reservoir shall superimposed on the space, complex oil-water distribution.

### **E. Preservation conditions**

Yubei region development more sets of argillaceous rocks, and other regional cap rocks, has provided the safeguard for the oil and gas accumulation and preservation. Early middle caledonian, hercynian, Yubei region of hetianpalaeohigh experience erosion karst reservoir formation, and the first phase of oil and gas filling, the period of ordovician karst type hetianpalaeohigh trap, due to the lack of an effective seals formation is the main damage and loss of oil and gas on the reservoirs, preservation conditions [10]. Late hercynian, YuBei region through the second major oil and gas filling, carboniferous mudstone under extensive deposition of bachu group, on the kalshayi formation in the mudstone and shale section become regional cap rocks, especially the bachu group "-" the mudstone in thick mudstone block on the top middle ordovician weathering crust directly, is conducive to the preservation of oil and gas, Yubei 1 fault belt of drilling to confirm its effectiveness of oil and gas block. Himalayan period, reservoir change, in addition to the early formation of carboniferous - Permian thick cover layer, the bottom of the paleogene system of high quality cream mudstone cap rock, the oil and gas has the very good preservation effect.

## REFERENCES

- [1] PuXiugang, WuYongping, ZhouJiansheng, et al. Characteristics and exploration potential of lithologic-stratigraphic hydrocarbon reservoirs in Qikou sag of Dagang oilfield[J]. *Acta Petrolei Sinica*, 2007, 28(2):36-39.
- [2] Burnham, A.K., 1989, A Simple Model of Petroleum Formation and Cracking: Lawrence Livermore Laboratory report UCID 21665, March 1989. Basic review of the kinetic conversion of kerogens to hydrocarbons.
- [3] Chinn, E.W., 1991, The role of organic geochemistry in petroleum exploration: Basin Research Institute Bulletin, Louisiana State University, Baton Rouge, LA, p. 15–23. Short paper that summarizes petroleum geochemistry and its analytical techniques.
- [4] Durand, B., 1980, Sedimentary organic matter and kerogen: definition and quantitative importance of kerogen, in B. Durand, ed., *Kerogen: Techniq*, p. 13–14.
- [5] Herron, S.L., 1991, In situ evaluation of potential source rocks by wireline logs, in R.K.Merrill, ed., *Source and Migration Processes and Evaluation Techniques: AAPG Treatise of Petroleum Geology, Handbook of Petroleum Geology*, p. 127–134.
- [6] Meyer, B.L., and M.H. Nederlof, 1984, Identification of source rocks on wireline logs by density/resistivity and sonic transit time/resistivity crossplots: *AAPG Bulletin*, vol. 68, no.2, p. 121–129. Discusses the principles and application of well log analysis to identify source rocks.
- [7] Jackson, J.A., ed., 1997, *Glossary of Geology*, 4th Ed.: American Geological Institute, 769 p.
- [8] James, N.P., and H.H.J. Geldsetzer, 1984, Introduction, in H.H.J. Geldsetzer, N.P. James, and G.E. Tebbutt, eds., *Reefs -Canada and Adjacent Areas: Canadian Society of Petroleum Geologists Memoir 13*, p. 1–8.
- [9] Levenson, A.I., 1954, *Geology of Petroleum: San Francisco*, W.H. Freeman and Co., 703 p. Logan, W.E., 1844, *Canada Geological Survey Report of Progress*, p. 141.
- [10] Zhang zhaolu, Wang hua, Yang hong, oil and gas basin petroleum system study [ *J Oil and gas geology*, 2000, 21 (2) : 133-135.