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鄂尔多斯盆地木匠沟地区油页岩分布规律研究及资源量计算

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摘　要：鄂尔多斯盆地木匠沟地区油页岩是一套与煤伴生的油页岩沉积，其主要油页岩矿层分布在煤层的底部，厚度一般为1～2.5m，由东南到西北方向逐渐变薄，埋深逐渐变大，油页岩的分布受沉积环境和构造的控制。通过含油率、单井油页岩特征分析以及油页岩露头观察分析，明确了木匠沟地区油页岩的分布规律，在地势较低的区域油页岩的厚度较大，地势较高的区域较薄或尖灭；总结了油页岩的沉积特征及模式，油页岩分布于湖湾沉积环境，并最终计算了该地区页岩油的资源量。

关键词：油页岩；资源量计算；分布规律；控制因素；木匠沟；鄂尔多斯盆地

中图分类号：TE122.9　　文献标识码：A

油页岩主要分为3种成因类型：①大型湖泊中沉积的油页岩；②在海平面附近水循环被限制的大陆架或者陆棚上的浅海形成的油页岩；③产煤沼泽有关的小型湖泊、泥泽和小碱湖[1]。鄂尔多斯盆地侏罗系油页岩以与煤伴生的油页岩为主，对木匠沟地区油页岩的研究可以对鄂尔多斯盆地侏罗系油页岩的勘探与开发工作起到一定的指导作用，并为建立鄂尔多斯盆地与煤伴生的油页岩的成矿模式提供一定的理论基础。

1 地质概况

鄂尔多斯盆地木匠沟矿区位于东胜东南35km处，在伊金霍洛旗的东北部，大地构造位置处于鄂尔多斯盆地伊盟隆起带，其地形平缓，为一片连绵不断的丘陵地带，山脊平坦，可通行车辆。该区位于鄂尔多斯地台向斜北部，由于有刚性强的前震旦系基岩为基础，组成了鄂尔多斯地台骨架，鄂尔多斯地台显得特别稳定，因而构造很简单。

木匠沟地区的地层主要有：中侏罗统延安组、中侏罗统直罗组和第四系地层。延安组在该区分布广泛，油页岩主要赋存于此地层中，其岩性主要为灰色、灰白色及黄绿色细砂岩、灰色砂质页岩、暗色泥岩、油页岩和煤，该层中主要发育4层煤和1层油页岩，其中油页岩顶板为第一层煤，底板为砂岩（图1）。

2 油页岩分布特征

木匠沟油页岩呈褐黑色及黑色，豆饼状和板状。岩层产状近于水平，岩层走向一般在15°～30°之间，倾向北西，倾角在 5°～10°之间。油页岩埋藏较浅，深者不到30m，一般为10～20m，该层油页岩最大厚度超过2.5m，平均厚度为1.66m。在矿区的东部油页岩出露于地表，其厚度约在2m左右，风化成浅色片状，中部油页岩品质较好，表面见浅黄色的硫，其顶层为一套煤层（图2）。

木匠沟地区油页岩南北向分布比较稳定，厚度变

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图1 木匠沟地区综合柱状图

Fig.1 Composite columnar section of Mujianggou Area

化不大，但东西向上分布不是很稳定，变化较大，矿区中心厚度超过2m，向四周逐渐变薄，渐至尖灭，并有分叉现象，在矿区的西部变化成6～7薄层，并有的成为碳质泥岩，说明沉积环境已发生了变化。整个木匠沟地区油页岩的分布范围较小，边缘地带相变强烈，体现了油页岩在湖湾地带分布的局限性。

3 油页岩沉积环境

木匠沟地区油页岩主要赋存于陆相沉积岩系，形成于中生代侏罗纪，属内陆湖泊和沼泽相。三叠纪末到侏罗纪时，鄂尔多斯地台向斜气候愈显潮湿，地形也发生变化，逐渐下沉，形成了湖泊和沼泽，鱼类和瓣鳃类等淡水动物逐渐繁盛，陆地上森林植物也很茂密[2]，特别是在延安组沉积时期，盆地内气候温暖湿润，形成了以湖泊、沼泽、湖湾、河流为主的沉积环境，良好的气候及有利的沉积环境为油页岩的形成创造了良好的条件。

油页岩形成于深水或半深水湖泊区域，有时也发育于三角洲体系中局部动能很小的深水环境及湖湾环境，形成于深水或半深水湖泊环境的油页岩一般分布较稳定，分布于湖湾环境的油页岩多分布较局限，厚度较小。煤层和暗色泥岩主要聚集环境为三角洲体系。其中，沼泽地带、分流间湾、小型湖、废弃分流河道、滨岸、浅湖、泛滥平原、岸后沼泽、河道之间、冲积扇扇前、冲积扇扇间洼地等都可以是煤层和暗色泥岩聚集

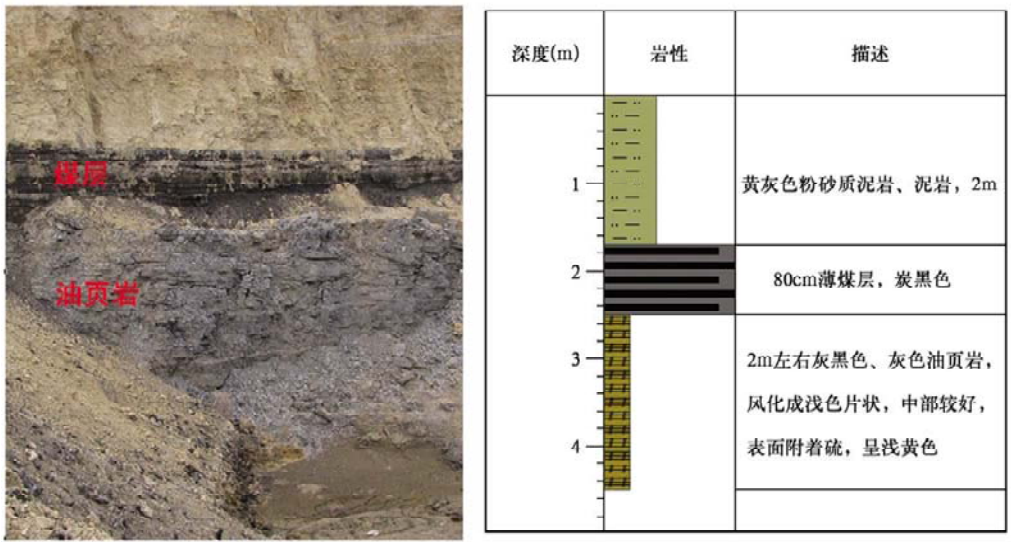

图2 木匠沟地区野外油页岩露头（左）及柱状图（右）

Fig.2 Field oil shale outcrop (left) and columnar section (right) of Mujianggou Area

的环境[3]。鄂尔多斯盆地东北部暗色泥岩发育很普遍，其常夹有菱铁矿结核、钙质结核、石灰岩透镜体（具叠锥构造）、煤线等，发育水平层理，富含完整的植物化石及其碎片、根化石、孢粉化石和双壳纲动物化石;其矿物成分以黏土矿物高岭石为主，伊利石为次，少量绿泥石。粉砂岩以粉砂级石英碎屑为主，少量长石碎屑和岩屑[4]。

在油页岩沉积的范围内，油页岩的底界构造呈现出一个小的低洼地，向四周海拔逐渐增高。油页岩的分布受此构造的影响，在海拔较低的区域，油页岩的厚度较大，反之则较薄;煤层的分布正好与油页岩的分布相反，构造较低的区域煤层的分布相对较薄，而构造较高的区域煤层分布较厚，说明油页岩和煤层的分布主要受构造的影响，在低洼地区，水体较深限制了高等植物的繁盛，导致油页岩分布较厚。

木匠沟地区油页岩主要分布于湖湾相沉积的水体中，湖湾中的油页岩分布面积较局限，大多与煤伴生，油页岩中含有较多的陆相植物碎屑。河流三角洲对油页岩的分布有较大的影响，河流三角洲发育的区域大多水动力条件较好，水体动荡，不利于油页岩的形成（图3）。

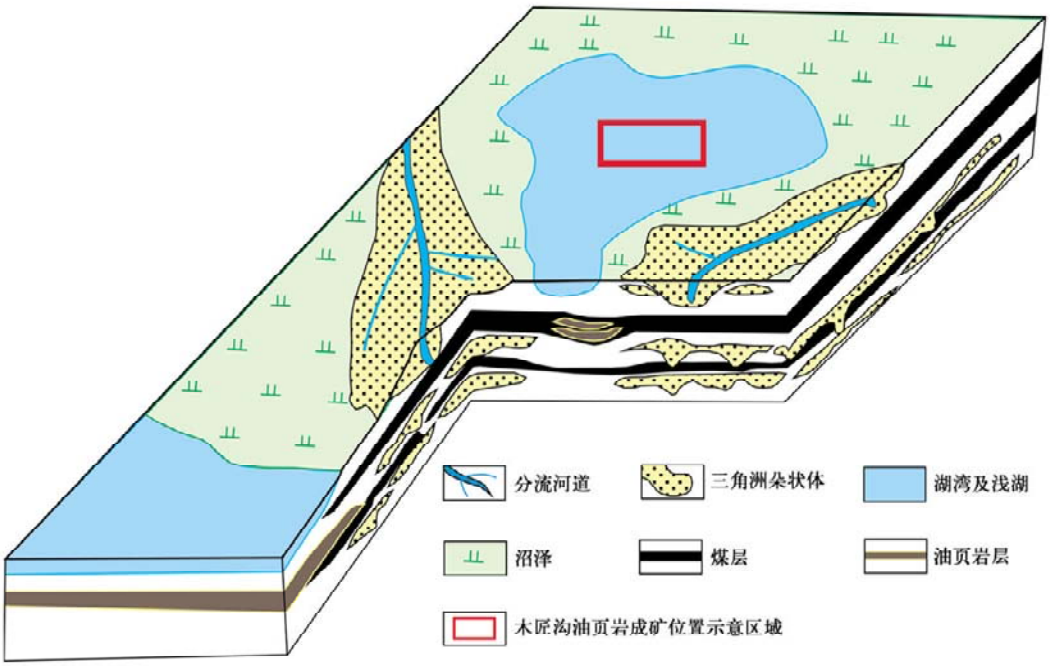

图3 木匠沟地区油页岩成矿模式

Fig.3 Oil shale forming model of Mujianggou Area

4 油页岩资源量计算

本文主要采用重量法对木匠沟地区的油页岩资源量进行计算，其计算公式如下[5]:

$$Q=S\cdot H\cdot D\cdot \omega$$

式中 Q——页岩油资源量，t；

S——油页岩面积，m^2；

H——油页岩厚度，m；

D——油页岩密度，g/cm^3；

ω——油页岩含油率，%。

通过对该地区13个样品含油率的分析，取算术平均值作为此次资源量计算的含油率值，该区域油页岩的密度为1.78g/cm^3，取0.5m以上为计算的有效厚度，通过计算，得出区域内页岩油的资源量为60.8×10^4t（表1）。

表1 木匠沟地区储量计算表

Table 1 Calculation of reserves in Mujianggou Area

油页岩层	厚度(m)	密度(g/cm^3)	含油率(%)	面积(km^2)	储量(t)
第一层	1.4	1.78	6.8	3.59	608347

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此区域的油页岩资源量相对较小，但油页岩的分布面积较小，且埋深较小，与交通距离较近，非常适合于露天开采。

5 结　论

木匠沟地区的油页岩分布于侏罗系延安组地层中，油页岩厚度一般在1～2.5m之间，南北向分布比较稳定，厚度变化不大，但是东西向上分布不是很稳定，厚度变化较大。

木匠沟地区油页岩属湖湾相沉积，与煤相伴生，当水体变深时，沉积以油页岩为主，当水体变浅时，沉积以煤为主。油页岩的分布主要受沉积环境和构造的影响，构造较低的区域沉积以油页岩为主，构造较高的区域沉积以煤为主。

木匠沟地区页岩油的资源量为60.8×10^4t，分布于3.59km^{2}的区域内，含油率较高，埋藏较浅，交通方便，利于露天开采。

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gas reservoirs have been discovered in the system, which pioneered a new field for natural gas exploration in Sanhu Area. By evaluating the basic geological background for the generation of lithologic gas reservoirs in terms of tectonic settings, gas source conditions, and source-reservoir-caprock assemblage, on the basis of simply reviewing the exploration course, this paper analyses the geological and seismic features of the lithologic reservoirs. In view of the features of lithologic reservoirs, this paper puts forward the research method for precise seismic data processing, precise isochronic stratigrahic framework correlation, and precise gas bearing test, providing technical support for further exploration study in lithologic reservoirs of the Area.

Key words: Sanhu Area; Quaternary; lithologic gas reservoir; gas bearing test

Distribution Study and Resources Calculation of Oil Shale in Mujianggou Area, Ordos Basin/Liang Feng[1], Liu Renhe[1], Bai Wenhua[1], Gao Zhiliang[2]// *1. Research Institute of Petroleum Exploration and Development-Langfang, Langfang City, Hebei Province 065007; 2. China University of Petroleum, Beijing 102249*

Abstract: Oil shale in Mujianggou Area of Ordos Basin is a set of oil shale sediments associated with coal, and the major oil shale layers are mainly distributed at the bottom of coal bed, with the thickness ranging from 1m to 2.5 m. These oil shale layers get thinner gradually from southeast to northwest, of which the burial depth gets larger. Oil shale distribution is controlled by sedimentary environment and structures. Through oil-bearing rate analysis, single-well oil shale features analysis, and oil shale outcrop survey analysis, the distribution law of oil shale in Mujianggou Area is determined. Oil shale is thicker in the low-lying area, while it is thinner or dies out in higher area. This paper also sums up the sedimentary features and models of oil shale which is distributed in the sediments of bays and lakes. Finally the resources of oil shale in the area are calculated.

Key words: oil shale; resources calculation; distribution law; controlling factor; Mujianggou; Ordos Basin

Sedimentary Filling and Reservoir Formation Response of the First Member of Yaojia Formation, Songliao Basin/Zhang Chenchen[1], Fu Xiuli[2], Zhang Shun[2], Chao Xia[3]//*1. China University of Geosciences, Beijing 100083; 2. Daqing Oil Field E&D Research Institute, Daqing City, Heilongjiang Province 163712; 3. No.6 Oil Production Plant of Daqing Oil Field, Daqing City, Heilongjiang Province 163700*

Abstract: Putaohua oil layers of the First Member of Yaojia Formation in Songliao Basin are large lacustrine delta sediments, and they have the characteristics of lower generation and upper storage. Oil reservoirs are mainly distributed within the range of source rocks of the central depression. The large delta complex in the north developed along the long axis of the Basin macroscopically controls the reservoir distribution. Different sedimentary facies control the distribution of the types of sand body and traps, so reservoir types present zonality on the plane. Reservoirs could hence be classified into structural reservoir, complex reservoir and lithologic reservoir. Oil and gas reservoirs controlled by high mature source rocks control concentrate in the central depressions. Oil and gas reservoir formation could be transported through unconformable surface. Oil and gas reservoirs mainly developed in the Highstand Systems Tract, while aqueous layers mainly developed in the Regressive Systems Tract.

Key words: Songliao Basin; the First Member of Yaojia Formation; large lacustrine delta; reservoir distribution

Natural Gas Occurrence and Distribution Pattern of Western Sag of Liaohe Exploration Area/Gao Gang[1], Huang Zhilong[1], Liu Baohong[2], Fan Hongche[1]// *1. State Key Laboratory of Petroleum Resource and Prospecting, China University of Petroleum, Beijing 102249; 2. Research Institute of Exploration and Development, Liaohe Oilfield Company, Panjin City, Liaoning Province 124010*

Abstract: The natural gas of western sag of Liaohe exploration area is widely distributed and the oil and gas are accompanied with each other. Hence this paper analyzes the migration, accumulation and distribution pattern of the natural gas combining with its composition and source characteristics, the exsolution features of crude oil dissolved gas and petroleum geology condition. Vertically, condensate gas reservoir, oil reservoir, gas cap reservoir, and gas reservoir are distributed from bottom to top successively at the same exploration area. Horizontally, natural gas is mainly distributed in the hydrocarbon generation sags. Dry gas is primarily distributed in the shallow part of the hydrocarbon generation sags and in the slope of neighborhood, while wet gas is distributed at different depths. Dry gas from the First Member to the Second Member of Shahejie Formation is mainly distributed in the hydrocarbon generation sags and their neighborhood, while the dry gas from the Third Member to the Fourth Member is mainly in the slope zone around the sags. The crude oil dissolved gas is the major source of natural gas accumulated in independent phase. There are four different types of natural gas reservoir-forming patterns the sags with different structures. Shallow gas is rich in the effective traps over the oil reservoirs of hydrocarbon generation sags; the deep formation of the hydrocarbon generation depression and the salient around are important areas of high maturity natural gas exploration.

Key words: natural gas; dissolved gas in crude oil; accumulation model; western sag; Liaohe exploration area

Interpretation of "Non-restricted Exploration"/Liu Chuanhu//*SINOPEC Shengli Oilfield Company, Dongying City, Shandong Province 257001*

Abstract: In view of the increasing proportion of subtle reservoirs, using examples of successful domestic and overseas exploration, this paper introduces a new idea of "non-restricted exploration". Study shows that oil and gas resources assessment is a process of deepening understanding, and innovative thinking could bring new exploration results. For example, Chunguang Oilfield, a shallow high-quality reservoir, was discovered by creating the oil and gas accumulation model of western margin of the Junggar Basin; Puguang gas field was found in the old basin by innovating geological knowledge and transforming exploration strategy. Innovation of geological theory could reveal the real features of reservoir formation. For example, new reserves potential was shown in the old exploration area of Shengli Oilfield through the creation of continental rift basin subtle reservoir exploration theory; a bar and shoal