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Resources Conditions of Coalbed Methane Districts in China

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Abstract The China National Administration of Coal Geology accomplished an assessment of coalbed methane resources of China in 1988. The total amount of coalbed methane resources in China is 14336.944 billion m^3 , occurring in recoverable coal seams and beneath weathering zones, with coalbed methane content equal to or higher than 4 m^3 per ton and buried depths smaller than 2000 m, among which there are 967.51 billion m^3 of predicted reserves and 13369.434 billion m^3 of future reserves. The resources in coal reservoirs with methane content of more than 8 m^3 per ton are 12444.087 billion m^3 , and those with methane content between 4 to 8 m^3 per ton are 1892.856 billion m^3 . There are 35 districts in which the resources abundance is higher than 150 million m^3/km^2 , 49 districts with the abundance between 50 million and 150 million m^3/km^2 , and 31 districts with the abundance less than 50 million m^3/km^2 . There is 9256.078 billion m^3 of methane occurring in coal seams with buried depths less than 1500 m, and 5080.866 billion m^3 in coal seams with buried depths between 1500 and 2000 m. There are 28 large-scale districts in which coalbed methane resources are more than 100 billions m^3 , 28 medium-scale districts with coalbed methane resources between 20 billion and 100 billion m^3 and 59 small-scale districts with resources amount less than 20 billion m^3 . The Jincheng area is one of the most favourable districts for coalbed methane resources in China.

Key words: coalbed methane, resources assessment, resources amount, target district, China.

1 Introduction

The China National Administration of Coal Geology has classified the distribution areas of national coalbed methane resources as 5 methane-accumulating regions, 30 methane-accumulating zones and 115 target districts when assessing the coalbed methane resources all over the country in 1998 (Ye et al., 1999). The types of the coalbed methane resources are classified as predicted reserves and future reserves (Tang et al., 1999a). And coalbeds can be divided into methane-rich ones with methane content more than 8 m^3/t , methane-contained coalbeds with methane content between 4 and 8 m^3/t , and methane-deficient coalbeds with methane content of less than 4 m^3/t (Tang et al., 1999b). In China, the total amount of coalbed methane resources from the minable coals, which are under the weathering zone with the methane content more than 4 m^3/t and a burial depth of less than 2000 metres, amount to 14336.944 billion m^3 . Of all the reserves, 422.324 billion m^3 accounting

for 2.95% of the total is in Northeast China; 9552.832 billion m^3 accounting for 66.63% is in North China; 234.057 billion m^3 , 1.63%, is in Northwest China, and 4127.731 billion m^3 , 28.7%, is in South China. There are no coalbed methane resources complying with the assessing qualification in the Yunnan-Tibet coalbed methane-accumulating region.

2 Types of the Resources in Coalbed Methane-accumulating Target Districts of China

The predicted reserves can be the foundation for assessing and selecting districts. But the future reserves can not be used for assessing and selecting districts. Different proportions of predicted reserves in the target districts reflect the grade of the resources and the degree of reliability in those districts. Table 1 shows the types of the resources in coalbed methane accumulating districts of China.

Table 1 Coalbed methane resources in various target districts of China

Coalbed methane-accumulating region	Coalbed methane target districts with different proportions of predicted reserves	
	Predicted reserves more than 25% of the total	Predicted reserves between 10 % to 25% of the total
Northeast China	Tiefa, Fushun	Fuxin, North of Shengyan, Hongyang
North China	Jincheng, Kailuan, Xishan of Taiyuan, Shizuishan, Ruqigou, North of Yellow River, Pingdingshan	Jiaozuo, Anyang-Hebi, Yangquan-Shouyan, Lu'an, Weizhou, Xingong, Yanlong, Xin'an, Yuxian
Northwest China	Jinyuan-Baojishan	Yaojie-Haishiwan, Ürümqi-Laojunmiao, Baiyanghe
South China	Changxing-Guangde, Leping, Fengcheng, Pingxiang, Chenlei, Quren, Guangwuang, Junlian, Hongmao, Panzhihua	Yangqiao-Yuancun, Lianshao, Hetianci, Ecengshan, Zhongshang, Northern Huayingshan, Middle Huayingshan, Tianfu, Luoguanshan, Nantong, Songzao, Furong

In Table 1, there are 20 methane accumulating districts whose predicted reserves are more than 25% of the total, in which 2 in Northeast China, 7 in North China, 1 in Northwest China and 10 in South China. The reliability of the coalbed methane resources in these regions is relatively high.

The assessment of the nationwide coalbed methane resources gave coalbed methane reserves of 14336.944 billion m^3 , in which the predicted reserves are 967.50 billion m^3 accounting for 6.75%, and the future reserves 13369.434 billion m^3 accounting for 93.25%.

From the view of the regionalism, the following provinces or autonomous regions have predicted coalbed methane reserves of more than 10 billion m^3 : Shanxi, Henan, Guizhou, Sichuan, Shaanxi, Anhui, Hebei, Liaoning, Yunnan, Xinjiang, Ningxia and Jiangxi. The total reserves of Gansu and Heilongjiang provinces are relatively large, but the proportions of

predicted reserves are small (Chen Zongqing, 1985; Chen Jianping et al., 1998; Long et al., 1998; Zhao et al., 1998; Wang et al., 1998; Chen Jianping et al., 1999).

3 Resources Grades of Coalbed Methane-accumulating Target Districts in China

In the selection of geological districts and the assessment of economic conditions, it is of great importance to take coalbed methane content into account. Calculation of reserves has not been done for the methane with content less than 4 m^3/t in consideration of economic mineability. The total coalbed methane reserves with methane content more than 8 m^3/t obtained in China are 12444.087 billion m^3 , accounting for 86.8% of the total, and those with methane content between 4 and 8 m^3/t are 1892.856 m^3 , accounting for 13.2%. Table 2 shows the grade of the coalbed

Table 2 The grade of coalbed methane reserves in methane-accumulating regions in China

Methane-accumulating region	Target districts in which methane-rich coalbed reserves are more than 85%
Northeast China	Jixian-Suibing, Shuangyashan, Jixi, Boli, Fushun, Hongyang, Hunjiang
North China	Jincheng, Yangquan-Shouyang, Heshun-Zuoquan, Lu'an, Huodong, Huozhou, Sanjiaobei, Liliu-Sanjiao, Wupu, Hancheng, Chenghe, Pubai, Ruqigou, Xingong, Yanlong, Xin'an, Shanmian, Dengfeng, Xinmi, Yuxian, Huaibei, Daqinshang, Xuanhua-Xiahuayuan, Xinglong, Liujiang, Kailuan, Jiaozuo, Anyang-Hebi, Lincheng, Linshang
Northwest China	Ürümqi-Baiyanghe, Aiweiergou
South China	Changxing-Guangde, Leping, Fengcheng, Yangqiao-Yuancun, Pingxiang, Lianshao, Middle Huayingshan, Tianfu, Zhongliangshan, Libixia, Xishan of east Sichuan, Luoguanshan, Qinshanling, Gufoshan, Nantong, Songzao, Guxu, Furong, Junlian, North-west of Guizhou, North Guizhou, Liupanshui, Zhina, Guiyang, Hongmao, Luocheng, Heshan

Table 3 Resources abundance of the coalbed methane-accumulating target districts in China

Methane-accumulating region	Coalbed methane-accumulating target districts with various resources abundances (100 million m ³ /km ²)	
	Resources abundance more than 1.5	Resources abundance between 0.5–1.5
Northeast China	Hegang, Fushun, Hongyang	Jixian-Suibing, Shuangyashan, Jixi, Boli, Tiefa, Fuxin, Northern Shengyang, Hunjiang
North China	Daqingshan, Kailuan, Jiaozuo, Anyang-Hebi, Yangquan-Shouyang, Lu'an, Jincheng, Liliu-Sanjiao, Northern Saojiao, Wupu, Hancheng, Shizuishan, Hulusitai, Xing-gong, Xinmi, Huainan, Huaibei	Xinglong, Jiyu, Liujiang, Dacheng, Fengfeng, Lincheng, Heshun-Zuoquan, Huodong, Xishan of Taiyuan, Huozhou, Ningwu, Fugu, Xiangning, Chenghe, Pubai, Qingyang, Zhuozishan, Maliantan, Ruqigou, Weizhou, Xin'an, Yiluo, Dengfeng, Yanlong, Yuxian, Pingdingshan, Jiulishan of Xuzhou
Northwest China	Ürümqi-Laojunmiao, Ürümqi-Baiyanghe, Fukang-Dahuangshan, Ehuobulake, Aiweiargou	Jingyuan-Baojishan, Yaojie-Haishiwan, Muli, Yuka
South China	Pingxiang, Zhongliangshan, Libixia, Xishan of East Sichuan, Gufoshan, Songzao, Guishan, Liupanshui, Zhina, Panzhihua	Leping, Chenlei, Tianfu, Nantong, Nanwu, Guxu, Furong, Junlian, North Guizhou, Enhong

methane reserves in China.

From Table 2, one can see that there are 66 methane-accumulating districts where methane-rich reserves are more than 85%, of which 7 in Northeast China, 30 in North China, 2 in Northwest China and 27 in South China.

The following provinces have total coalbed methane reserves larger than 100 billion m³ and methane-rich reserves more than 85%: Shanxi, Guizhou, Shaanxi, Henan and Anhui. The total coalbed methane reserves of Sichuan, Heilongjiang, Liaoning, Gansu, Hebei, Yunnan and Xinjiang are also more than 100 billions m³, but their methane-rich reserves proportions are relatively low.

4 Resources Abundance of the Coalbed Methane-accumulating Target Districts in China

The abundance of coalbed methane resources represents the coalbed methane reserves in unit area. In the 115 target districts, there are 35 with the abundance more than 0.15 billion m³/km², 49 between 0.05 billion and 0.15 billion m³/km², and 31 less than 50 million m³/km² (Table 3).

Within the 35 coalbed methane target districts with the abundance of resources more than 150 millions m³/km², there are 3 in Northeast China, 17 in North China, 5 in Northwest China and 10 in South China.

The coalbed reserves in all the target districts with

the abundance more than 150 million m³/km² add up to 7751.3 billion m³, accounting for 54% of the total, those with the abundance between 50 and 150 million m³/km², 6046.3 billion m³ accounting for 42%, and those with the abundance less than 50 million m³/km² account for 4%.

5 Depth of the Resources in the Coalbed Methane-accumulating Target Districts of China

Considering the economic and technological conditions and the practical situation of the coal prospecting in China, only coalbed methane reserves with burial depths smaller than 1500 m and between 1500 and 2000 m, were estimated: 9256.078 billions m³ with burial depths smaller than 1500 m, accounting for 64.56% and 5080.866 billion m³ with a burial depths between 1500 m and 2000 m accounting for 35.44%. Table 4 illustrates the burial depth distribution of the coalbed methane target districts in China.

On average, the reserves with burial depths smaller than 1500 m account for 68.1% in Northeast China, 55.6% in North China, 69.22% in Northwest China and 84.86% in South China.

There are 10 provinces and an autonomous region where coalbed methane reserves with burial depths smaller than 1500 m exceed 100 billion m³. They are Shanxi, Guizhou, Henan, Shaanxi, Sichuan, Gansu, Yunnan, Anhui, Hebei, Heilongjiang and Xinjiang,

among which Shanxi and Guizhou provinces have reserves of 3084.589 billion m³ and 2564.375 billion m³, respectively.

6 Scales of Resources in Coalbed Methane-accumulating Target Districts of China

In the nationwide coalbed methane assessment, the target districts were classified into three groups based on the amount of resources. They are: (1) large-scale target methane-accumulating districts with reserves larger than 100 billion m³; (2) medium-scale target methane-accumulating districts with reserves between 20 and 100 billion m³; (3) small-scale target methane-accumulating districts with reserves smaller than 20 billion m³. Therefore, of the 115 coalbed methane-accumulating districts, there are 28 large-scale, 28 medium-scale and 59 small-scale ones. The scale distribution of the coalbed methane-accumulating districts is shown in Table 5.

From Table 5 one can see that as regards the large-

scale target districts, North China is the main distribution region, where 21 target districts are distributed and the next are South China and Northwest China, where 5 and 1 target districts are distributed respectively. The medium-scale target districts are mainly distributed in North China (13 districts) and South China (10 districts) and there are 4 middle-scale target districts in Northeast China and 1 in Northwest China.

Besides, there are 59 small-scale gas accumulating target districts, among which 6 in Northeast China, 17 in North China, 8 in Northwest China and 28 in South China.

7 Conclusion

The above analysis indicates that the Jincheng target district, as a large-scale gas-accumulating region, meets another four conditions: (1) the proportion of predicted reserves is more than 25%; (2) the proportion of coalbed methane resources from methane-rich coal beds is more than 85%; (3) the abundance of

Table 4 Burial depths of the resources in the coalbed methane target districts of China

Methane-accumulating regions	Target districts where coalbed methane reserves with burial depths smaller than 1500 m account for 85% or more
Northeast China	Tiefu, Fuxin, North Shengyang, Fushun, Hunjiang
North China	Daqingshan, Xuanhua-Xiahuayuan, Liujiang, Jiyu, Lincheng, Lingshan, Jincheng, Huodong, Xishan Tianyuan, Zhuozishan, Shizuishan, Ruqigou, North Yellow River, Jiulishan of Xuzhou
Northwest China	Yaojie-Haishiwan, Ürümqi-Laojunmiao, Fukang-Dahuangshan, Ehuobulake
South China	All the target districts except for the Middle Huayingshan, Xingyi, Liupanshui, Zhina

Table 5 Resources scales of the coalbed methane-accumulating target districts in China

Methane-accumulating region	Large-scale coalbed methane-accumulating districts	Medium-scale coalbed methane-accumulating districts
Northeast China	Jixi	Hegang, Jixian-Suibing, Boli, Hongyang
North China	Qingyang, Yangquan-Shouyang, Huodong, Heshun-Zuoquan, Lu'an, Sanjiaobei, Liliu-Sanjiao, Wupu, Xiangning, Dacheng, Huainan, Fugu Hancheng, Jincheng, Huaibei, Jiaozuo, Xingong, Anyang-Hebi, Xishan of Tainyuan, Chenghe, Ningwu	Kailuan, Fengfeng, Huozhou, Pubai, Tongchuan, Weizhou, Yanlong, Xin'an, Dengfeng, Xinmi, Yuxian, Pingdingshan, Yongxia
Northwest	Ürümqi-Baiyanghe	Aiweiergou
South China	Liupanshui, Zhina, North Guizhou, Guishan, Guiyang	Fengcheng, Zhongliangshan, Libixia, Songzao, Guxu, Furong, Junlian, Zhenxiong Enhong, Xingyi

coalbed methane resources is more than 150 million m^3/km^2 ; and (4) the proportion of the reserves from burial depths smaller than 1500 m is more than 85%. Therefore, the Jincheng target district is an area most favourable for the prospecting of coalbed methane resources, which has been verified by recent exploration and exploitation work.

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