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Synthetical Analysis on Geological Factors Ccontrolling Coalbed Methane

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Abstract

The gas-controlling property is the important content for the coalbed methane (CBM) theoretical research, and it has the important role for guiding the CBM exploration and development. The evolution features of the coal-bearing strata and structure and the current CBM preservation condition are the keys determining the CBM enrichment and reservoir formation. In the case that the earth curst is stable in the sedimentary period of the coal-bearing strata and after the coal-bearing strata are deposited, the coal seam deposited by the coal-accumulation has the large and stable thickness, the earth curst is stably subsided after the coal-accumulation period or the strength of the structural movement is low and the uplifted amplitude is little, then it is favorable for the CBM enrichment. In the area there the coal-bearing strata have the simple structure, the enclosing rock of coal seam is stable and compact, the seam buried depth is deep, and in the stagnant area with the simple hydrogeological condition, the CBM-controlling property is well. The research on the CBM-controlling property is restricted by the exploration degree, with respect to the area with the low exploration degree, the research on the CBM-controlling property could be combined with the exploration results of the area with the high exploration degree, on the basis of analysing the CBM distribution features and control factors of the area with the high exploration degree, adopting the analysis method such as the geological analogy and so on, it conducts the research work from the evolution features of the coal-bearing strata andstructure and the current CBM preservation condition.

Keywords : Exploration degree, coalbed methane, control factor, synthetical analysis;

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1. Introduction

The CBM exploration and development in our country already have the history near 20 years. Up to data, it had constructed more 5000 CBM wells of various kinds. They are mainly distributed in the coaldata, it had constructed more 5000 CBM wells of various kinds. They are mainly distributed in the coal mining areas or in the areas near to the coal mining areas, the exploration scope is limited and the exploration degree is low; the areas with the higher CBM exploration degree are mainly located in the Qinshui Basin, the eastern margin of the Ordos Basin and the Fuxin Basin; the more successful areas in CBM exploration are the Jincheng mining area in Shanxi, Fuxin mining area in Liaoning and Hancheng mining area in Shaanxi; in other areas there has not the large breakthrough, its main cause is that the geological conditions of coal fields in our country are varied, and the gas-controlling geological factors are complicated.

The CBM is occurred in the coal seam mainly by the adsorbed state, and the coal field prospecting and CBM exploration could be supplemented mutually. At present, the coal field prospecting mutually. At present, the coal field prospecting is mainly restricted in the area with the depth less than 1000m, moreover, in this depth scope the prospecting degree is uneven, in the coal mining area the coal field prospecting degree is higher, can attaining to the exploration stage, and out of the coal mining area the prospecting degree mostly is lower. With respect to the area with the lower exploration degree, it can accord to the geological data of the area with the higher exploration degree and adopt the analogy analysis method to research its gas-controlling property. In this paper, combining with the geological condition of main coal fields in our country, the main impact factors of CBM-controlling property are researched with the hope of guiding the CBM exploration and development in our country.

2. Analysis on CBM-controlling property

The CBM research, exploration and development practices indicated that the main CBM-controlling geological factors include the evolution degree of coal, structure and its distribution features, coal seam buried depth, lithology of seam roof and floor, and material composition of coal, etc. The research on the CBM-controlling property shall be started from two aspects: the evolution features of the coal-bearing strata and structure and the current CBM preservation conditions.

2.1. Evolution features of the coal-bearing strata and structure

The evolution of the coal-bearing strata and structure refers to the process in which the seam burying, coal thermal evolution, as well as the CBM generation, storage and preservation conditions are continuously varied, accompanying with the structural movement occurred in the sedimentary period of the coal-bearing strata and after the sedimentary period, and is the high summary of the CBM reservoir formation process. The current CBM reservoir is controlled by the earth crust stability in the sedimentary period of the coal-bearing strata and after the sedimentary period, as well as the reformation of the coal-bearing strata by the structural movement occurred after the deposition of the coal-bearing strata.

2.1.1. Coal accumulation

The coal accumulation is the base determining the current CBM reservoir, and it directly determining whether the CBM generated from coal evolution could be enriched and formed the gas reservoir. The coal accumulation is related to the sedimentary thickness, stability and texture of the coal seam and so on in one hand, and is related to the thickness, lithology and combination of the coal-bearing strata in another hand.

In our country, there are many coal-forming periods of coal fields, the distribution scope of coal fields is wide, and the sedimentary system is differentiated. Under the control by the deposition, the lithology and combination of the coal-bearing strata, as well as the seam stability are varied largely in different basins. In the Early Cretaceous coal-bearing strata developed in the northeastern part of the Heilongjiang Province, in the Hegang coal field it is mainly the continental facies river, alluvial fan and lake sediments, the coal-bearing members Shitouhezi Formation and Shitoumiaozi Formation all are constituted by the conglomerate, sandstone with various grain sizes, as well as the tuff and argillaceous rock, the seam roof and floor are unstable and the lithology is varied largely, and the self preservation condition of coal-bearing strata is poor; moreover, the lower part of the Shitouhezi Formation is the Beidaling basal conglomerate, the upper part is apart from the Shitoumiaozi Formation by the Nanling conglomerate, and the sealing property of the upper and lower strata of the coal-bearing strata is poor, therefore, the CBM content is lower. The Sanjiang–Mulenghe coal-bearing area is mainly the alluvial fan, river and delta sediments of the continental-oceanic interaction facies, the coal-bearing members are the Chengzihe Formation and Muleng Formation, and is constituted mainly by the sandstone, mudstone, conglomerate, tuff and coal seam, and the CBM preservation condition by the deposition is better than that in the Hegang coal field, therefore, the gas content also is higher. In the Qinshui Basin in Shanxi Province, the Late Paleozoic coal-bearing strata are developed, the main coal-bearing members are the Taiyuan Formation and Shanxi Formation, the sedimentary system appears as the transitional evolution from epicontinental sea to continental environment; in the Taiyuan period the epicontinental sea environment is the main body, it develops the carbonate platform, barrier- island–lagoon and deltaic sedimentary system, it is constituted by the sandstone, siltstone, mudstone, limestone and coal seam, and the coal seam and rock layer are stable. In the Shanxi period it is mainly the delta sediment, intercalating with the paleo-geographical landscope of the continental environment and epicontinental coastal environment, it develops the sedimentary combination dominated by the deltaic system intercalating with the river system and barrier–lagoon system, the sediments are the sandstone, siltstone, mudstone and coal seam, and the coal seam and rock layer are more stable. Therefore, in the Qinshui Basin the coal accumulation results in that the coal seams in the Taiyuan Formation and Shanxi Formation and the overlying rock layers are stable and the lithology is compact, and it is favorable for the CBM preservation and reservoir formation.

2.1.2. Structure and deposition

The formation of the CBM reservoir is accompanied with the whole structural reform process of the basin, the structural movement controls the deposition and evolution of the coal-bearing strata, thereby it also controls the structural pattern, the final distribution state of the coal-bearing strata, the coal metamorphic regularity and the CBM distribution state and so on, and it determines the final form of the CBM reservoir. In all of the structural movements, the structural movement after the coal-bearing strata deposition has the largest impact on the CBM reservoir formation.

Within the Shandong Province the CBM content in the Permo- Carbonigerous coal fields is lower universally, the main cause is that after the deposition of the coal-bearing strata, the structural movement results in the uplifting of the coal-bearing strata, the overburden suffers the serious denudation, so that a lot of generated CBM is escaped, thereafter the earth crust occurs not the further evolution and gas generation, so the gas content is lower universally. The structure and deposition features after the deposition of coal-bearing strata determine that the gas content in the Shandong coal fields is low. After the deposition the Early Cretaceous coal-bearing strata developed in the northeastern part of the Heilongjiang Province pass through the multiple-period reformation of the Yanshan movement and Hymalayan movement, the coal-bearing strata are uplifted, the subsiding is frequent, it results in the depositional break and the serious denudation of the previously deposited strata, and in the local area a part of strata is wholly denuded, so that a lot of CBM generated by the previous deposition and evolution

is escaped. From the structural movement and deposition it can be seen that in the northeastern part of the Heilongjiang Province the high gas-bearing area also could not be occurred.

In the Ordos Basin, after the deposition the Permo-Carboniferous strata also pass through the impacts of the multiple-period structural movements, the crust subsiding and uplifting are frequent, however, the total trend is dominated by the subsiding, so it is favorable for the coal evolution, gas generation and the CBM storage and prevention. The Jinxi flexible fold zone is located in the eastern margin of the basin, the exploration degree is high, although it suffers the uplifting and denudation of the multiple-period structural movements, the CBM preservation condition is better, and the gas content is higher; the Northern Shaanxi slope is located in the central part of the basin, the exploration degree is lower, but based on the analysis it is considered that the uplifting and denudation degree of this area is lower than that of the Jinxi flexible fold zone, therefore, the CBM preservation condition is more superior, the gas-controlling property is better, and the gas content is higher. The structural thermal evolution pattern of the Permo-Carboniferous coal-bearing strata in the Ordos Basin is shown in Fig.1.

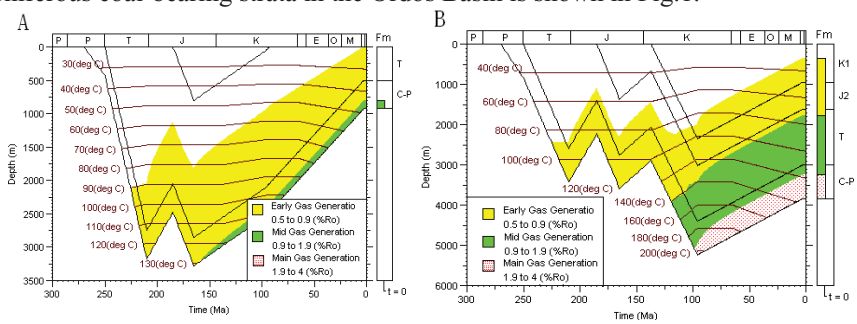

Fig. 1. The structural thermal evolution pattern of the Permo-Carboniferous coal-bearing strata in the Ordos Basin

2.1.3. Coal evolution and hydrocarbon generation

The coal evolution and hydrocarbon generation are the key links for the CBM enrichment and reservoir formation. The sufficient generated hydrocarbon quantity is the prerequisite ensuring the CBM enrichment and reservoir formation.

The coal rank is the final result of the coal metamorphism and evolution in the deposition process, it is the most important index determining the CBM generating capacity, and is one of the gas-controlling factors. The coal evolution occur not the sudden variation generally, and within a definite of scope it has the identical property mostly. In the Ordos Basin, after the deposition the Permo-Carboniferous strata pass through the multiple structural uplifting and subsiding processes, but the total trend is dominated by the subsiding, the coal evolution is mainly by the deep-seated metamorphism, and in the end period of the Early Cretaceous and in the local area the magma intrusion results in the increase of the coal evolution degree. Under the impacts in the aspects of the structure, magmatic activity and the deposition of coal-bearing strata and overburden, in the different areas the coal metamorphism and evolution degree are somewhat differentiated, in most areas the coal evolution degree is higher, dominated by the moderate-high metamorphic coking coal, lean coal and meagre coal, the coal has the strong gas-generating capacity, the generated gas quantity is large, and the current CBM content also is high, mostly 10 ~ 20m3/t; however, in the Jungar area in the northeastern part, the coal metamorphic degree is low, mainly is the low metamorphic long-flame coal, the coal has the weak gas-generating capacity, the generated gas quantity is little, and the current CBM content also is low, mostly below 3m3/t. Therefore it could be inferred wholly that in the northeastern part of the Ordos Basin the coal metamorphic degree of the

Permo-Carboniferous strata is low, the gas-controlled property is poor, and in other areas the coal evolution degree is high, and the gas-controlled property is well.

2.2. Current CBM preservation conditions

The current CBM preservation conditions are the key for the CBM reservoir formation, and is the aspect should be considered emphatically in the CBM exploration and development. The researches indicated that the current CBM preservation conditions mainly include three aspects: the development and distribution features of the structure, coal seam occurrence condition and hydrogeological condition.

2.2.1. Development and distribution of the structure

The development and distribution situations of the structure has the stronger control role on the CBM reservoir formation, and has many the control role on CBM by the faulting and folding. Under the impact of the regional structural movement, in one basin or coal field, the development and distribution situations of the structure all have a definite of variation regularity.

The Ordos Basin is a more stable large-type basin in our country, wholly the structure is simpler, but there have larger differences in different areas, wholly it appears as that the structure in the basin margin area is more complicated, towards the basin interior the structure becomes simple gradually, and the CBM preservation condition also appears as that it becomes well gradually from the basin margin to the basin interior.

Due to the different properties, the faulting structure also has the different sealing roles on CBM. Due to its open property, the tensional faulting is favorable for the CBM migration, the gas-controlling property is poor, and lets the CBM content is reduced; the compressional and compressional-shear fault have the poor open property, and they have the stronger fragmentation on CBM, so they are favorable for the CBM enrichment. The coal field exploration in the Jixi mining area, Heilongjiang Province, indicated that in the vicinity of the normal fault the CBM content is low, while in the vicinity of the reversed fault the CBM content is higher (Table 1). The production practices of various coal mines at home also indicated that in the vicinity of the compressional -shear fault the occurrence rate of the coal and gas outburst and high gas emission is higher. At the southern flank of No.1 district in Jinjia mine, Guizhou Province, the open fault is developed, in the mining process of No.7 seam, the gas discharge is 6 ~ 14m3/min; at the northern flank of the district the structure is simple, the CBM preservable condition is well, in the mining process of coal, the gas discharge is large, and two times of gas outburst accident were happened [1].

Table 1. Gas content measured in borehole in Jixi mining area

Borehole	Seam	Buried depth (m)	Gas content (m^3/t)	Fault property
ZK1	No.7	944.5	3.6	F_{32} normal fault
ZK2	No.7	364.1	8.46	Reversed fault

Wang Shengquan (2002) had analyzed various structure types exposed practically in the production mines and the gas content of No.3 seam in the Xiayukou and Liaoyuan minefields in Hancheng mining area, and considered that the large-moderate-type folded structure and flexible structure have the different control roles on gas content, moreover the different structural positions also have the different impacts on the gas content in seam, the gas- controlling property at syncline axial part is the best, and the CBM content is the highest, in average 12.65m^3/t; at the flat dip zone and the flexible anticline positions the gas-controlling property is better, and the CBM content is higher, in average 9.62m^3/t and 9.38m^3/t

respectively; the gas-controlling property at anticline axial part is the poorest, and the CBM content is the lowest, in average 7.31m^3/t .

Under the control by the structural movement, the dip angle of the strata could be varied, and has the impact on the gas content. In the Gemudi and Panguan synclines, Guizhou Province, the gas content data measured in coal field exploration indicated that in the marginal area of the syncline the dip angle of the strata is larger, the CBM content is lower, and in the area where the strata are gentle the gas content is higher. On this basis it is inferred that in the interior of the syncline where the coal field exploration degree is lower, the suffered impact degree from the structure is small, the strata are flat, the dip angle is small, the CBM preservation condition is well, and the gas content is high.

2.2.2. Coal seam occurrence condition

The control role of the coal seam occurrence condition on CBM includes mainly two aspects: coal seam buried depth and coal seam enclosing rock condition. The occurrence condition is controlled by the deposition and the structural movement after the deposition of coal-bearing strata. In the region the variation regularities of the seam buried depth and the lithology and thickness of the overburden are more obvious commonly.

a. Coal seam buried depth

The control role of the coal seam occurrence condition on CBM includes mainly two aspects: coal seam buried depth and coal seam enclosing rock condition.

b. Coal seam buried depth

The control role of the coal seam occurrence condition on CBM includes mainly both aspects: coal seam buried depth and coal seam enclosing rock condition. The coal seam buried depth has the larger impact on the CBM occurrence, in one hand, with the increase of the seam buried depth, the thickness of the overburden of the coal-bearing strata is increased, the sealing role on CBM is enhanced, and the CBM content is increased, this situation is occurred in most of the coal fields at home; in another hand, the CBM takes the adsorption storage as the main occurrence form, its adsorption capacity suffers the stronger control role from the coal reservoir pressure, with the increase of the coal reservoir pressure, the adsorption storage capacity is enhanced, and it is favorable for CBM storage and preservation.

The CBM theoretical research and the exploration and development practices indicate that the coal reservoir pressure is controlled mainly by the seam buried depth, with the increase of the seam buried depth, the coal reservoir pressure appears the increase trend. In the southern part of the Qinshui Basin the CBM exploration degree is higher, and the tested reservoir pressure and seam buried depth have the better correlation property. It is analysed thereby that with the increase of the seam buried depth, the CBM preservation condition also will become well.

c. Coal seam enclosing rock condition

The coal seam enclosing rock condition includes both aspects: one is the lithology and distribution situation of coal-bearing stratum itself, and another is the lithology and distribution situation of seam roof and floor. The lithology and distribution of the enclosing rock are controlled by the sedimentary environment during the geological period, and they mostly have a definite of variation regularity in the region.

Under the control by the sedimentary environment, in the continental- oceanic interaction facies sedimentary system the coal-bearing strata are stable, the proportion of the fine clastic rock is high, and the CBM sealing condition is well in general. The Permo-Carboniferous coal-bearing strata in the Qinshui Basin are mainly constituted by the mudstone, siltstone, fine sandstone, limestone and coal seam and so on, the coal seam and rock layer are stable, moreover the proportion of the mudstone and siltstone is high, in the Shanxi Formation, the mudstone and siltstone occupy 52% ~ 59% of the formation thickness of this formation; and in the Taiyuan Formation, the mudstone and siltstone occupy 44% ~ 60%. While in the

continental facies sedimentary coal-bearing strata the stability of the coal seam and rock layer is relatively poorer, medium and coarse sandstone and even the conglomerate all are more developed, the sealing condition of the coal-bearing stratum itself is poor, and the CBM is easy to escape. In the Hegang coal field, the Early Cretaceous coal-bearing strata are dominated by the conglomerate, coarse ~ fine sandstone, the coarse clastic rock exceeds 45%, the siltstone and mudstone are little, and the sealing role on CBM by the coal-bearing stratum itself is poor.

As the first line of the sealed bed for CBM, the coal seam roof and floor have the decided control role on CBM. The fine clastic rock such as the mudstone and siltstone has the better sealing property, the sealing condition of the sandstone is poorer, the sealing condition of the limestone is differentiated due to the uneven development of its pore, fracture and karst, but wholly its sealing capacity is poorer. The stability of the enclosing rock is often controlled by the sedimentary environment. In the Qinshui Basin, the Shanxi Formation and Taiyuan Formation are the marine facies sedimentary system, the rock layers all are more stable regionally; in the Shanxi Formation the roof of No.3 seam is mainly the mudstone, the CBM sealing condition is well and the gas content is high; while in the Taiyuan Formation which is located below No.3 seam, the roof of No.15 seam is the limestone, the CBM sealing condition is relatively poorer, and the gas content is lower than that of No.3 seam wholly. It also is the same in the Ordos Basin, in the Shanxi Formation the roof of No.5 seam is mainly the mudstone, in the Taiyuan Formation the roof of No.8 seam is mostly the limestone, and the gas content in No.8 seam is lower than that in No.5 seam wholly. The Fushun coal field is the continental facies lake sedimentary system, the metamorphic degree of the coal seam is low, mainly is the long-flame coal and gas coal, but because the direct roof of the coal seam is the huge-thick oil shale, so the CBM preservation condition is superior, and the CBM content is higher.

In the Sanjiang–Mulenghe coal-bearing area and Hegang coal field, the Early Cretaceous coal seam is mainly the fat coal and coking coal; compared with other coal fields having the identical metamorphic stage in our country, the gas content is lower, commonly 2 ~ 5m3/t, and the main cause is that the CBM preservation condition by the enclosing rock is poor. In the Sanjiang– Mulenghe coal-bearing area the Early Cretaceous coal-bearing strata are mainly the alluvial fan, river and deltaic sediments; in the Hegang coal field the Early Cretaceous coal-bearing strata are river, alluvial fan and lake sediments; under the control by the deposition, in these areas the lithology of the coal seam roof and floor is unstable, and the lithology is coarser; in the Hegang coal field it mainly is the medium sandstone, and in the Sanjiang– Mulenghe coal-bearing area it mainly is the medium-fine sandstone, so the enclosing rock condition is unfavorable for the CBM preservation. At the same time, in these areas the structure is developed, the large faults mostly cut through the seam roof and floor, destroy the integrity of the enclosing rock, let the CBM preservation condition become poor, and the CBM content is lower.

2.2.3. Hydrogeological conditions

The control role on CBM by the hydrogeological conditions appears in both aspects: one is that the groundwater runoff carries out continuously the CBM by the solution form, and results in the reduction of the CBM content; the another is that the groundwater sealing and the coal reservoir pressure increase caused from the groundwater results in the enhance of the adsorption capacity. The research on the CBM-controlling property by the current hydrogeological condition is not beyond both aspects: the distribution and water-bearing property of the aquifers in the vertical direction; the runoff features of groundwater regionally. The distribution of the aquifers is controlled by the deposition during the geological period, and the circulation of the groundwater regionally also has a definite of regularity.

The roles of the hydrogeological conditions on the CBM reservoir formation mainly appear in both aspects: one is that the favorable confined water condition can effectively seal the shallow weathered outcrop of the coal reservoir, and then it can restrain the weathered zone extending to the deep; the

another is that in the nonactive water dynamic situation, as the confined water state it fills into the limestone or sandstone above, below and interior of the coal-bearing strata, it forms the shield on CBM reservoir, and it can effectively prevent the CBM escape. In the Tangshan area, Hebei Province, in the Kaiping syncline, the Tang-4 and Tang-5 shafts are located separately in the upper wall and lower wall of the fault; the salinity of the formation water in Tang-4 shaft is 350mg/l, and 2000mg/l in Tang-5 shaft; in the upper wall of the fault the water in seam is connected with the atmosphere, while the lower wall is a relatively stagnant area, the CBM sealing condition is relatively better, and it provides the favorable area for the CBM exploration [3].

The Hancheng mining area, which is located in the eastern margin of the Ordos Basin, is a monocline CBM reservoir formation mode wholly (Fig.2). In the interior of the coal-bearing strata the main target seams for reservoir formation are Nos.3, 5 and 11 seams, the eastern outcrop area of the coal-bearing strata is the eastern boundary of the gas reservoir, in the western part it extends to the basin interior and constitutes as a whole with the Ordos Basin, and forms a continuous and stable gas reservoir; the water-rich property of the aquifers in coal-bearing strata and the overlying aquifers is poor, and the aquifuges are developed. In the region, the groundwater runs off from east to west, the runoff speed is reduced gradually, and the strength is weakened gradually. Therefore, from the distribution situation of the groundwater it can be seen that the eastern part of the Hancheng mining area is the groundwater recharge and runoff area, the long-period runoff of the groundwater carries out a lot of CBM as the solution form, and results in the reduction of the CBM content in eastern part; while towards the western part of the mining area, the groundwater runoff could form the lateral sealing of groundwater within a definite of depth scope, so that the CBM preservation condition become better; at the same time, towards the western part of the mining area, the runoff activity of the groundwater is weakened, is transited gradually to the confined state, the coal reservoir pressure is increased, and then it results in the enhance of the CBM adsorption and storage capacity. In the vertical direction, the roofs of Nos.3 and 5 seams in Shanxi Formation are mainly the mudstone, it is a better aquifuge, it cuts off the vertical hydraulic connections between the aquifers and between the aquifer and coal seam, the CBM preservation condition is well, and the gas content is high. The roof of No.11 seams in Taiyuan Formation is the limestone, the water-rich property of the limestone is relatively stronger. It constitutes the hydraulic connection with No.11 seam, so that the gas content is lower than that of Nos.3 and 5 seams [4]. The CBM exploration and development practices in USA also indicated that in partial area the groundwater has the stronger control role on CBM; in the San Juan Basin the coal reservoir pressure is higher, the main cause is that the outcrop area of the coal-bearing strata in the northern part of the basin is recharged by the groundwater, and runs off towards the basin interior, in the basin interior it is transformed to the confined state (Fig.3), and in the deep area the increase of the reservoir pressure also results in the CBM preservation condition becoming better gradually.

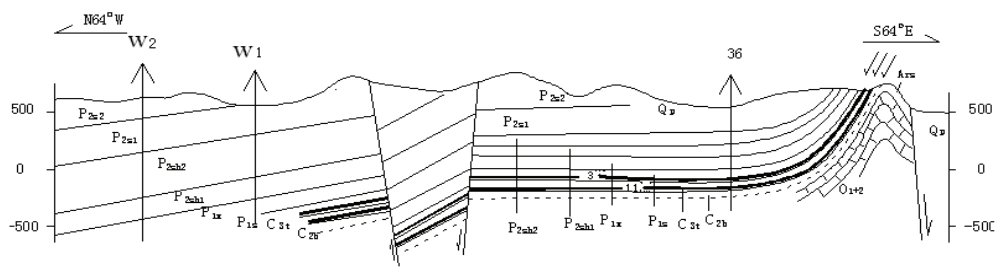

Fig. 2. The CBM reservoir formation mode in the Hancheng mining area

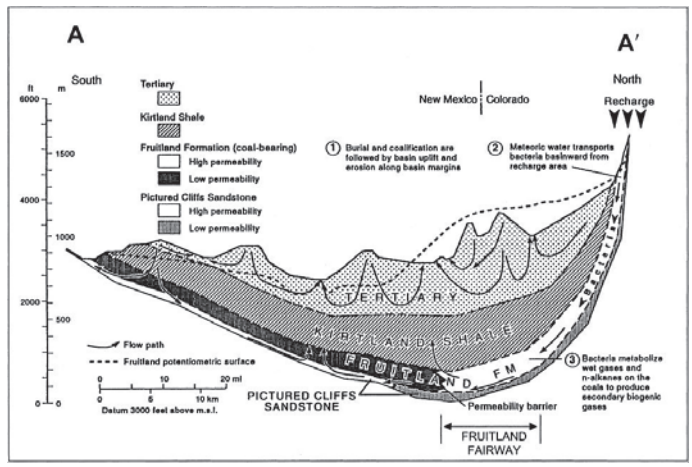

Fig. 3. The groundwater system profile in the San Juan Basin (After A.R. Scott, 1994)

In the South China area, the control role of groundwater on CBM is displayed outstandingly. The underlying rock layer of the Longtan coal- bearing strata is the Maokou limestone with the thickness of 100 ~ 300m, and is the permeable rock layer of karst-fracture type. When the gas-isolating layer between the coal seam and Maokou limestone is thinner or is lacked, the CBM is easy to dissolve and is carried out by the groundwater. In the Hunan Province, in the "North type Longtan coal-bearing strata" the interval between the Maokou limestone and coal seam is 0 ~ 10m, the karst water in the Maokou limestone is strongly active, so that the Enkou and Meitanba mines have the large water quantity and low CBM content; while in the "South type Longtan coal-bearing strata" the interval between the Maokou limestone coal seam is larger, 300 ~ 400m, between them there has the better gas-isolating layer, so that some coal mines in the Hongshandian–Chenlei coal field have the small water quantity and high CBM content, and become the high gassy or outburst mines [6].

3. Conclusions

a. The earth crust stability in the deposition period of the coal-bearing strata and the reform degree of the coal-bearing strata by the structural movement after the deposition of the coal-bearing strata control the current distribution of the CBM reservoir. The coal accumulation is the base determining the current CBM reservoir formation, the different sedimentary environments in the coal-accumulation period determine deposited thickness of the coal seam and rock layer and the difference of the lithology, and the sedimentary environment and the structural evolution after the coal-forming period are the base for research the CBM reservoir formation. In the area there in the deposition period of the coal-bearing strata and after the deposition the crust is stable, the seam deposited by the coal accumulation has the stable and large thickness, after the coal-accumulation period the crust is stably subsided with large amplitude, or the structural movement strength is low and the uplifted amplitude is small, it is favorable for the CBM enrichment.

b. The development and distribution features of the structure, coal seam occurrence condition and hydrogeological condition are the main control factors on the current CBM reservoir formation. Under the impact of the regional structural movement, in one basin or coal field, the development and distribution

situations of the structure and the coal seam occurrence condition all have a definite of variation regularity. The distribution of the aquifer and the circulation of the groundwater regionally also has a definite of regularity. In the area there the coal-bearing strata have the simple structure, the enclosing rock of coal seam is stable and compact, the seam buried depth is deep, and in the stagnant area with the simple hydrogeological condition, the CBM-controlling property is well.

c. In the area with the low exploration degree, the research on the CBM-controlling property could adopt the geological analogy method, and combined with the exploration results of the area with the high exploration degree, conduct the research from the evolution features of the coal-bearing strata and structure and the current CBM preservation condition.

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