

ORIGINAL RESEARCH ARTICLE

Comparative study on Hydrogeological conditions of Huaihe mining area

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ABSTRACT

Lianghuai Mining Area is one of the 13 large coal bases in China. It is an important coal and coal production base in China. Mine water inrush accidents occur frequently, resulting in economic and human resource losses, reflecting the importance of the study of hydrogeology in mining areas. In this paper, the hydrogeological conditions of Bozhou and Huainan Panxie mine are analyzed, and the similarities and differences between the hydrogeological conditions of the two mines are summarized. The shallow pore water group in the Bozhou area is composed of the Quaternary system of the Quaternary system (Q4d) and the upper part of the upper part of the Mao Tong group (Q3m). The lithology of the aquifer is silt, silt and fine sand. The shallow pore water group of the Panxian Pancho Formation in Huainan is composed of the Upper Pleistocene of the Quaternary system and the Holocene strata. The lithology is mainly composed of fine sand. The main sources of shallow pore water supply in the two areas are precipitation infiltration, mainly for evaporation, lateral runoff, artificial mining and deep flow and discharge to the river.

KEYWORDS: Lianghuai; Mining area; Hydrogeological; Shallow pore water

1. Introduction

1.1. Research significance

Two Huai mining area is one of the 13 large coal bases in China, involving Huainan, Huaibei, Suzhou, Fuyang, Bozhou, Bengbu 6 city jurisdiction 10 districts and 7 counties. There is 8.5 billion tons of coal in Huaibei mining area, such as coking coal, 1/3 coking coal, gas coal, fat coal, lean coal, lean coal, anthracite and natural coke, coal quality is low sulfur, Low phosphorus, high heat, strong adhesion, and good coke 'green' coal. Huaibei mining area is rich in reserves, complete coal, coal quality is excellent, widely distributed, large scale deposits, comprehensive benefits highlights, has become China's important coal and coal production base. Huainan for the national 100 million tons of coal base, East China Thermal Power Base and coal chemical industry base of the 'three bases', East China's industrial 'heart.' The economy is mainly heavy industry, coal industry as a pillar industry, has proven coal reserves of 44.4 billion tons. By 2010, coal production will reach about 100 million tons. Is one of the 13 billion tons of coal base.

Groundwater on the one hand can be used as mine life and industrial water supply, in the hydraulic mining of coal can be used in groundwater for water, water, water; the other hand, groundwater is the main source of water into the mine, an increase of mine drainage Costs, some of the mine due to water conditions are complex, strong water filling, affecting the mineral has been identified cannot be carried out as soon as possible. For some of the production of mines, due to the influx of groundwater, the impact of light mining efficiency, while the resulting flooded mining areas, mines, forcing production to stop. Therefore, it is of great significance to study the hydrological and geological conditions of the mine and analyze the various factors that cause the mine water damage, and to control the water damage and ensure the safe production of the mine.

1.2. Research status

Mine gushing water is a common phenomenon in the development of mineral resources, ranging from production, increase the cost of coal mining, while submerging the mine and causing personal injury and death and major property damage. It is the basic task of the hydrogeology of coal mine to master the basic law of coal mine hydrogeology, and to carry out the following main research progress in recent years.

(1) Water-saving coal mining technology: water-saving coal mining is for the northern Shanxi Jurassic coal field development process in the fourth quarter of the Salawu group groundwater to the mine water and the ecological environment continues to deteriorate the problem put forward.

(2) North China coal mine water control technology system: North China coal field is China's major coal production base, Carboniferous - Permian coal-bearing strata directly unconformity in the Ordovician limestone, is a typical karst water-filled coal mine Bed, hydrogeological conditions are very complex, to solve the problem of coal mine water damage in the region for the sustainable development of China's coal industry is of great significance.

(3) the development of the collapse of the column and its governance technology: Since June 2, 1984 Kailuan Fan Guozhuang 2171 working face karst collapse column large water inrush accident, the collapse of the pillars of the safety of coal mine production has caused widespread concern. The research on the causes, distribution and water diversion of the trapping column has become a hot and difficult problem. In recent years, in view of the special hydrogeological environment of the North China Coalfield, the Chinese scholars have systematically studied the water diversion and water blocking mechanism of the subsidence column from the aspects of the structural mechanics of the surrounding rock and the hydraulic conditions of the rock.

1.3. Research content

Lianghuai mining area is one of the 13 large-scale coal bases in China, which has a positive effect on China's industrial production and economic development. Based on the available data, the author briefly introduces the geological conditions of Huainan and Huaibei, and analyzes and compares the hydrogeological conditions of the two mining areas respectively, and summarizes the similarities and differences between them.

2. Water and hydrology Conditions of Huaibei Mining Area

2.1. Geographic location

Huaibei mining area is located in the northern part of Anhui Province, east of the east to the east, west to Henan and Anhui provinces, south from the bridge fracture, north to Jiangsu and Anhui border, a total area of 9600 square kilometers, Area of 6912 square kilometers, including Sui Xiao, Suxian, Lin Huan, Guoyang four mining areas. The total mining area reserves of 8.5 billion tons of coal, coking coal, 1/3 coking coal, coal, coal, lean coal, lean coal, anthracite and natural coke and other major coal, coal quality is low sulfur, Low phosphorus, high heat, strong adhesion, good coke 'green' type of coal.

2.2. Geological profile

The Huaibei area is located in the southeastern margin of the North China plate. The main body belongs to the Xu-sheng depression in the south-central part of the Luxi-Xuhuai uplift area, which is sandwiched between the abundant and uplift of the east-west and the Bengbu uplift, which is bounded by the Tanlu fault zone. The structural framework is controlled by the active zone of the south and east sides of the south and east, which is characterized by the fold fracture of the SN near (slightly NNE) controlled by the Tan-Lu fault, superimposed and cut the early EW-tectonic structure, forming a diamond- And the formation of the Xu-Su-shaped double-punch-stack fan thrust system with linear closed folds and thrust-stack faults as the main features.

The strata of the Huaibei area include the Archean, the Mesoproterozoic Qingbaikou, Sinian, Paleozoic Cambrian, Ordovician, Carboniferous, Permian, Mesozoic Triassic, Jurassic and Cretaceous, Cenozoic Paleogene, Neogene and Quaternary.

2.3. Hydrological profiles

The upper part of the area is tectonic eroded low mountain residual hill, exposed Aurora, Cambrian, Ordovician and Carboniferous strata, the vast majority of the Cenozoic loose layer covered, low mountain elevation of 180 ~ 408m, plain surface elevation 20 ~ 50m , The terrain northwest high southeast low. The river belongs to the Huaihe River

system, mainly the gate river, the Sui River, the Tuohe River, the river and the vortex river, etc., is a seasonal river, the average annual flow of $3.52 \sim 2.10 \text{ m}^3 / \text{s}$, the average annual water level is $14.73 \sim 26.5 \text{ m}$.

2.4. Bozhou hydrogeological conditions

According to the conditions of water medium, gap type and groundwater, the groundwater type in the area can be divided into three types: loose rock pore water, carbonate rock fissure cave water and bedrock fissure water.

1. Loose rock pore water

According to the burial conditions of the aquifer, the top and bottom can be divided into shallow pore aquifer group (50m shallow), deep first porosity aquifer group (50-165m), deep second pore water layer (165-660m), and deep third porosity aquifer group (660-900 m).

(1) Shallow pore water layer (50m shallow)

It is composed of Quaternary system and Q3m (Q3m). The lithology of the aquifer is silt, silt and fine sand. In general, will under the 'binary structure' or the thickness of the 'multi-dimensional structure.' The development of 1-3 layers of larger thickness, sorting better fine sand layer, the cumulative thickness of 5.0-25.0m, sand layer between the non-stable cohesive soils separated by the water between the layers of water, is diving or semi-bearing Pressurized water. Water depth is 1.0-2.5m, along the vortex on both sides of the water depth of 2.0-4.0m. According to the result of borehole pumping test, the water discharge in the single well of the north of the vortex is $> 1000 \text{ m}^3 / \text{d}$; the water yield of the single well in the south of the vortex is $500-1000 \text{ m}^3 / \text{d}$. Water quality type is $\text{HCO}_3\text{-Ca}$ or $\text{HCO}_3\text{-Ca} \cdot \text{Mg}$ type, mineralization degree $< 1.0 \text{ g} / \text{l}$, PH value of 7.3. This layer is the main source of water for rural residents and agricultural irrigation.

Shallow groundwater buried shallow, directly receiving the precipitation recharge, the water level rises rapidly after the rain, showing precipitation infiltration - evaporation dynamic characteristics, the water level changes little, the annual water level peak in the 7-9 month flood season, 1-4 months Water level is stable, 5 - 6 months water level decline, after October the water level began to fall. Water level variation in 2.0-4.0m annually.

Shallow pore water supply sources: precipitation infiltration, surface water recharge and irrigation backflow, in which precipitation infiltration is the main source of shallow pore water supply. Excavations mainly are evaporation, lateral runoff, artificial mining and deep flow into the river and excretion.

(2) Deep first porous aquifer group (50-165m)

(Q1m), the lithology of aquifer is mainly composed of silt, fine sand and fine sand, which is mainly composed of coarse sand in gravel, With a 'multi-dimensional structure', the development of 2-3 layers of water-bearing sand layer, single layer thickness of 2.0-15.0m, the cumulative thickness of 10.0-40.0m. Groundwater nature comes with pressure, water depth is 1.5-8.5m and annual variation of 0.2-2.5m. According to the results of drilling and pumping test, single well watering $1000-2000 \text{ m}^3 / \text{d}$. Water quality type is $\text{HCO}_3\text{-Na}$ or $\text{HCO}_3 \cdot \text{SO}_4\text{-Na}$ type, mineralization degree of 1.0-1.5g / l, PH value of 7.5. The layer is the main mining layer for urban water supply.

The main source of the first pore water supply is mainly the lateral recharge of the aquifer and the small amount of vertical overflow recharge, the groundwater runoff is slower. Excavations mainly are artificial mining and lateral runoff.

(3) Deep second pore aquifer (165-660 m)

(N2m), the aquifer lithology is silt, fine sand, medium sand, local semi-cemented, developed two layers of water-bearing sand layer, the thickness of 10.0-40.0m. Groundwater nature based with pressure, water depth of 7.5-22.5m, the annual variable amplitude of 0.4-1.5m. According to the results of drilling and pumping test, single well watering $1000-2000 \text{ m}^3 / \text{d}$. Water quality type is $\text{HCO}_3\text{-Na}$ or $\text{HCO}_3 \cdot \text{Cl-Na}$ type, mineralization degree of 0.5-1.5g / l, PH value of 7.3. The groundwater is natural mineral water resources.

The secondary second pore water supply source is mainly the lateral recharge of the aquifer, and the groundwater runoff is slower. Excavations mainly are artificial mining and lateral runoff.

(4) Deep third porous aquifer group (660-900m)

(N1g), the aquifer is a loose - semi - cemented siltstone, fine sandstone, local coarse gravel. Groundwater nature based with pressure, water depth is around 38.0-44.5m, annual variation is 1.5-2.5m. According to the results of drilling and pumping test, single well watering $500-1000 \text{ m}^3 / \text{d}$. Water quality type is $\text{HCO}_3\text{-Na}$ or $\text{HCO}_3 \cdot \text{Cl-Na}$ type, mineralization degree of 0.5-1.5g / l, PH value of 7.4. The groundwater is rich in strontium, metasilicic acid and other minerals beneficial to the human body, water temperature $25-50 \text{ }^\circ\text{C}$, and natural geothermal mineral water resources.

The third source of the recharge of the deep pore water is mainly the lateral recharge of the aquifer, and the groundwater runoff is slow. Excavation is mainly lateral runoff.

2. Carbonate rock fissure cave water

The carbonate rocks distributed in the northwest part of the area are basically buried under the 350 μ m thick loose layer. The carbonate rocks distributed in the north-east part of the Guoyang County and the northwest of Mengcheng are shallowly buried below the loose layer of about 100m, Exposed to the surface. (C2), Ordovician Lower System (O1-2), Cambrian Lower System, Sinian System (Z2) Limestone, dolomitic limestone, dolomite, marl, etc., dissolution cracks, karst weak development, local development. According to the 'Mengcheng County, the second water plant preliminary design specifications', in the eastern part of the county Liangtu mountain area survey, to find more than 100 meters deep hidden karst in a considerable amount of karst water source, single well water content of 2000m³ / D. Water quality type is HCO₃-Ca · Mg type, mineralization degree <1.0g / l, static water depth of 5.0m or so.

Carbonate fissure cave water recharge source is mainly to obtain lateral runoff and overlying loose rock pore water supply. Excavation methods to artificial mining and lateral runoff-based, mainly in Mengcheng County water source for mining, other areas have not yet carried out karst water exploitation.

3. Bedrock fissure water

Hidden in the Qiaocheng District 10 Town, Qiao Dongzhen Temple, Guoyang County Yimen Town, Zhabei Town, Chengdong Town, Xiyang Town, Mengcheng County Xiajian Town and Lixin County Town, Kan Tuan Town, (T1), Permian under the system (P1-2), green and white mouth of the eight hill group (Qnbg), under the Sinian system (Z1w-Z1ss) and shale, mudstone, siltstone, sandstone and conglomerate, quartz sandstone, biotite slender gneiss, Flashing long gneiss, cracks are not developed, single well water inflow 10-100m³ / d, the current area has not yet mined.

3. Water and Geological Conditions of Huainan Mining Area

3.1. Geographic location

Huainan Coalfield is located in the south of Huaihe Plain in Anhui Province, the middle reaches of the Huaihe River, and Huainan mining area is one of the important coal production base, coal 32 to 40 layers, coal thickness of 42m, for coal mining. Mining east and west to 100 km long, north and south tilt width 20 ~ 25km, an area of 3000km². -1000m above has been proven coal geological reserves of 17.5Gt. According the statistic at end of 1999, the existing production of mine reserves is 1.463Gt.

3.2. Geological profile

The Huainan mining area is located on the southern margin of the North China plate and the west side of the Tanlu fault. Coalfield has a syncline structure at east Zheng (city) to Lu (river) fracture, the west of Zhoukou sag, north Bengbu uplift, and south of Hefei depression. The tectonic form is a near-east-west tectonic basin, and the north and south sides are thrust-tectonic tectonics. The interior is a double-inclined structure. The structure of the area is dominated by the west-west structure, which is strongly modified by the later stage, but the overall shape is not changed greatly.

In addition to the Mesozoic Jurassic and Paleozoic Silurian, the Devonian is absent, and the other strata are developed to varying degrees. Former Quaternary strata except the Upper Archean Huoqiu group, green and white mouth, Sinian, Cambrian, Ordovician, Cretaceous part of the surface exposed, the rest are covered by Quaternary.

3.3. Hydrological profile

Huaihe River is the largest river through the Huainan City, from the western edge of the Cambrian limestone, the two streams into the Huainan City, and then converges in the northeast of Xinzhuangzi mine. In addition to the Huaihe River, there are two tributaries of the Huaihe River (such as mud river, kiln river), the side of the lake (such as Gaotang Lake, ten streams, Wabu Lake, Qianjia Lake, Lake Stream, etc.) , As well as large and small reservoirs (such as the old Longyan reservoir, Rushan Reservoir, etc.).

3.4. Pan-Shekou's hydrogeological conditions

According to the characteristics of groundwater storage medium, the type of water-bearing porosity, the groundwater of Panxie mine is mainly three types: pore-bearing aquifer rock group, clastic rock pore water and carbonate fractured karst water. The depth of the buried rock is divided into shallow pore water, middle and deep pore water and deep pore water, which is divided into different subclasses. Since the main object of this study is shallow pore water, the report only analyzes the hydrogeological conditions of shallow pore water.

Shallow pore water is an open groundwater aquifer system, which is found in the strata of the Cenozoic loose rock. It is composed of the Pleistocene and the Holocene strata. The lithology is mainly composed of fine sand. The area of water rock group in the horizontal direction, the thickness is relatively uniform. The thickness of the aquifer is less than 10m, and the thickness of the aquifer sand layer is less than 10m. The thickness of the aquifer layer is less than 10m, the relative development of water-bearing sand layer, the thickness of water-bearing sand layer is generally greater than 10m. Groundwater hydraulic property is dive - micro-confined water, permeability coefficient of 1.2-2.5m / d. In natural conditions, groundwater depth is 1.0-2.0m.

The stratigraphic boundaries of the shallow groundwater are basically the same as those of the ancient riverbed, and the distribution direction of the ancient river channel is basically the same as that of the modern river channel. Shallow groundwater is divided into strong water-rich area, medium-rich water area and weak water-rich area according to water-rich. The rich water area is mainly distributed in the area of the ancient channel, and the water content of the single well is 40 ~ 60m³ / h. The middle water rich area is mainly distributed in the area of the ancient river channel ~ the floodplain phase and the ancient Hukou area, and the water flow of the single well is 25 ~ 40m³ / h; The ancient river basin, the ancient lake basin for the weak rich water area, single well water inflow 10 ~ 25m³ / h.

Natural conditions, shallow pore water supply, runoff and excretion conditions mainly depends on the weather, hydrology, stratigraphic lithology, tectonics and topography and other factors, these factors are independent and interrelated.

Shallow pore water mainly through the unsaturated zone to accept the infiltration of atmospheric precipitation infiltration, followed by irrigation and surface water infiltration recharge, which accounted for dominance of atmospheric precipitation infiltration, accounting for shallow groundwater total recharge of more than 86% Cited surface water irrigation leakage supply accounted for 6% to 8%, surface water infiltration recharge accounted for about 3%.

The flow direction of shallow pore water is consistent with that of ground, and the general trend is from northwest to southeast runoff, and the hydraulic gradient is about 1 / 10000-2 / 10000.

Diving evaporation is the main excretion of shallow pore water, followed by the vertical to the lower part of the deep pore water flow excreted, dry season to the river excretion and artificial mining excretion. In the case of increasing the degree of artificial mining, the shallow groundwater dynamics in this area are gradually transformed into precipitation - infiltration - diving evaporation, artificial mining and precipitation - infiltration - artificial by precipitation - infiltration - evaporation in the original natural condition Mining, evaporation direction.

The chemical changes of groundwater are mainly controlled by hydrogeological conditions and conditions such as precipitation recharge and runoff. The HCO₃-Ca, HCO₃-Ca-Na and HCO₃-Ca · Mg type are the main types of groundwater chemistry in the study area, the water temperature is 16.5-19 °C, and the total dissolved solids is 0.3-0.8g / l.

The dynamic changes of shallow pore water are influenced by terrain, topography, gas zone, lithology, precipitation and evaporation. The natural state is dominated by meteorological conditions and shows the dynamic characteristics of precipitation infiltration and evaporation. According to the analysis of the results of long-term observation hole data of Xieqiao underground water level in the study area (1975-2007), the seasonal variation of groundwater level in the area showed obvious seasonal variation, The average water level is 24.17m, the depth is 2.03m, and the water level in the period from May to July is the same as that of the water level in the first half of the year. The rainy season, the water level began to rise in July to reach the maximum, the water level of 25.33m, buried depth of less than 1m. After August, the groundwater level began to decline, to the following year in February to reach the lowest value. During the irrigation period, groundwater is affected by human activities and the water level has declined. The average annual groundwater level is 24.68m, and the annual mean change of water level is 1.16m.

4. Analysis contrast

(1) (Q4m) is composed of the Quaternary system of the Quaternary system (Q4d) and the upper and lower order group, and the aquifer lithology is composed of silt, silt, Fine sand. The shallow porosity and aquifer group in Huainan area is located in the strata of the Neoproterozoic strata, which is composed of the Quaternary system and the neoclassic strata. The lithology is mainly composed of fine sand.

(2) The water quality of shallow pore water in Bozhou area is HCO₃-Ca or HCO₃-Ca · Mg type, mineralization degree is less than 1.0g / l, The HCO₃-Ca, HCO₃-Ca-Na and HCO₃-Ca · Mg in the shallow pore water in Huainan area are mainly water temperature 16.5-19 °C and dissolved total solid 0.3-0.8g / l.

(3) The sources of shallow pore water supply in both regions are precipitation infiltration, surface water recharge and irrigation infiltration, and precipitation infiltration is the main source of shallow pore water supply. Excavations are mainly for evaporation, lateral runoff, artificial mining and deep flow to the river and excretion.

(4) The dynamic characteristics of groundwater are precipitation infiltration and evaporation, but in the case of increasing the degree of artificial mining, the shallow groundwater dynamics in Panxie mining area of Huainan is gradually transformed from the precipitation-infiltration-evaporation type under the original natural condition Precipitation - infiltration - diving evaporation, artificial mining and precipitation - infiltration - artificial mining, evaporation direction.

5. Conclusion

(1) Huaibei and Huainan mining areas are located on the southern margin of the North China plate and the west side of the Tanlu fault. The stratigraphic bottom-up is the Mesoproterozoic Qingbaikou, Sinian, Paleozoic Cambrian, Ordovician, Carboniferous, Permian, Mesozoic Triassic, Jurassic and Cretaceous, Cenozoic Quaternary.

(2) Huaibei River belongs to the Huaihe River system, mainly Zhahe River, Sui River, Tuohe River, River and Whirlpool River, is a seasonal river. Huainan in addition to the Huaihe River, there are two tributaries of the Huaihe River, next to the lake, mining collapse lake, and reservoirs.

(3) The water quality of shallow pore water in the Huaihe River area is $\text{HCO}_3\text{-Ca}$ or $\text{HCO}_3\text{-Ca} \cdot \text{Mg}$ type and the recharge source is mainly infiltration and infiltration. The main way is the diving evaporation.

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