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Analysis of Occurrence Conditions of Cretaceous Aquifer in Longdong Ningzheng Mining Area

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Abstract. In order to grasp the occurrence conditions of the Cretaceous aquifer in Longdong Ningzheng mining area, the types and laws of the aquifers in the area, hydrogeological characteristics, and recharge and excretion conditions were analyzed. The study found that the groundwater in the east of the Longdong Basin was replenished in three directions, and the south side was Excretion boundary. The early cretaceous aquifer is the most important groundwater in the Ningzheng mining area. The cretaceous aquifers of the Lower Cretaceous Huanhe Formation are widely distributed in the area. The shallow weathering fissures develop and communicate with each other, which is groundwater migration and a good place to live. The lithology of the pores and fissures of the Huanhe Formation is dark purple red siltstone and mudstone, which is a weak and water-rich aquifer. The lithology of the pores and fissures of the Luohe Formation is mainly purple-red and brown-red medium-grained sandstones. It is a medium-rich water-rich water-rich aquifer. The local borehole has a strong self-flowing water phenomenon. The aquifer recharge is mainly Subgrade recharge of the diving and infiltration replenishment of atmospheric precipitation.

1. Introduction

Longdong basin located in the southwestern margin of the Ordos basin, the eastern part of Gansu province. Longdong basin is the hinterland of the planned Longdong energy and chemical industry base [1-3]. It contains abundant resources such as coal, oil and natural gas. The basin ranges from the east to the Ziwuling, the south to the Weihe river, the west to the Liupanshan, and the north to the Baiyu mountain watershed. The terrain of the Longdong basin is inclined from the northeast to the west and faces the southeast. It is a non-closed basin that opens in the southwest [4-5]. The administrative area of the basin belongs to Pingliang city and Qingyang city, with a total area of $3.5 \times 10^4 \text{ km}^2$. Ningzheng mining area is located in Qingyang city. The landform is composed of loess, valley terraces and low hills, as shown in Fig.1. The climate is typical continental climate. The annual precipitation is 350~550mm. The water resources are scarce and the ecological environment is very fragile. Groundwater is the most important water sources in the region. With the implementation of the new round of the Western Development Strategy, the large-scale development of oil, coal and natural gas, the contradiction between water resources and economic development is increasingly intensified [6]. At present, the proven Cretaceous Luohe formation in the Longdong basin has a thick layer of underground freshwater and has a water supply significance for residents' lives. Therefore, it is of



great significance to analyze the occurrence conditions of the Cretaceous aquifer in the Longdong Ningzheng ming area.



Figure 1. Topography in the area

2. Groundwater type and distribution law

The Longdong basin is a relatively independent basin in the Ordos basin. The western boundary of the basin is the Pingliang-Pengyang, which is the recharge boundary [7-8]. The eastern boundary is the old stratigraphic outcrop distribution area east of Ziwuling, Ning County, which is the recharge boundary. The boundary is not closed, which is a supply boundary, and the southern boundary is drainage boundary, located at the Tingkou area of Binxian county. According to the hydraulic properties of groundwater and the characteristics of the interstitial space of the aquifer [9-10]. The groundwater in the area is divided into friable rock of quaternary fissure & pore phreatic; Cretaceous clastic rock weathering zone fissure phreatic and layered fissures pore, fissure confined water; Middle Jurassic Anding, Zhiluo formation, Yan'an formation fissure confined water; Triassic fissure confined water. The formation and occurrence conditions of each aquifer is comprehensively controlled by the factors of regional stratum lithology, geological structure, topography, landform and hydrometeorology. The groundwater in the mining area is dominated by bedrock-bearing water, followed by the quaternary phreatic. The deep Cretaceous Huanhe formation, Luohe formation and Jurassic Zhiluo formation, Yan'an formation and Triassic Yanchang group generally have confined water distribution. The submarine and confined waters of the early Cretaceous clastic rocks mainly refer to the Luohandong formation, the Huanhe formation fissures and weathering fissures, the annular fractured confined water of the Huanhe formation and the pores and fissure confined aquifers of the Luohe formation. The Luohandong formation generally has a small distribution area and is in a watershed zone with poor water-producing conditions.

2.1. Huanhe formation fissure phreatic of Cretaceous

The Huanhe formation is widely distributed in the region, mainly in the weathering fissures of the Huanhe formation in the banks of the Malian river, Chengbei river, Jiulong river and Silang river. In the exposed river valley area of the bedrock, the weathering zone of the bedrock is developed to the deep part through long-time weathering and the dissolution of groundwater. The thickness of the weathering zone is generally 50~60 m, and the depth of the Chengguan area in the county of Malianhe is 70~80m. The distribution of aquifers is relatively stable and has good continuity, which is conducive to the occurrence of groundwater in the development of joint fissures. In the loess girders and gully areas, the terrain is strongly cut, and the weathered fissure water phreatic is often excreted in the form of descending springs. The aquifer in the bedrock weathering zone of the interchannel area is buried under the quaternary loess. The occurrence of groundwater depends mainly on the development degree and recharge conditions of the fissures in the ancient weathering zone of the bedrock. Generally, the fissures in the weathered zone of the tableland are not developed. In addition, the clay in the bedrock weathering zone is covered with clay. The vertical infiltration replenishment conditions are poor, and

only a small amount of lateral bedding can be accepted, and the water volume is very weak. In the area of Chengguan to Wanli village in Ning county, Malian river, the Xiangle river Xiangle township and the Luziping of Jiulongchuan, Silanghe and other river valley areas are in a good water-rich area.

2.2. *The early cretaceous confined aquifer*

The early cretaceous is a monoclinic structure that is slightly inclined to the northwest, and forms a part of the eastern wing of the Mesozoic sloping basin in the region, which provides a good condition for the formation of confined water. The confined aquifers of the Huanhe formation are distributed in the west of Luoshan to Guanjiachuan. The depth of the roof burial in the valley area is 50~70m, and the thickness of the aquifer is about 57~140m. The lithology of the Luohe formation confined water aquifer is a thick layered sandstone with pores. The lithology is dense in the north, the lithology in the southeast is loose and broken, the upper part is denser in the vertical direction, and the lower part is looser. Therefore, the aquifers also have different conditions in the horizontal and vertical directions, and the aquifer is about 300~400 m. The depth of the aquifer is more than 270m in the valley area, and the depth of the roof of the inter-basin area is more than 500m. The pressure-bearing aquifer of Luohe formation increases from the east to the west with the increase of burial depth, and the runoff and catchment range expands, and the water-richness also changes from poor to good.

3. Hydrogeological characteristics of the early cretaceous

3.1. *Weathering fissure phreatic of the Huanhe river*

The lithology of the weathered fissures in the Huanhe formation is dominated by mudstones. The interbedded sandstones, shallow weathering fissures develop and transfixion with each other, which is a good place for groundwater migration and occurrence, as shown in Figure2. Weathered fissures are generally above the local erosion datum. The weathered fracture zone has a thickness of 30~60m. Because the weathered fissure zone is often connected with the quaternary strata, it forms a uniform aquifer with the upper aquifer, and is easy to accept the recharge of the upper gravel layer pores. The water alternates strongly. According to the drilling data, the aquifer is 51~100m thick, the burial depth is 3.73~53.6m, the drawdown is 4~30m, the unit-inflow is 0.046~0.533L/sm, the permeability coefficient is 0.14~1.0m/d, the degree of mineralization is 1.8~4.8 g/L, and the water chemistry type is SO₄-Ca·Na·Mg type.

3.2. *The early cretaceous pores, fissure confined water*

(1) The lithology of the pores & fissures of the Huanhe formation is dark purple red siltstone, mudstone, sandy mudstone and fine sandstone, and localized dissolution cavities, as shown in Fig.2. The total thickness of the stratum is 201~389m, and the thickness of the aquifer in the sandstone section is 60~90m, the water level is 990~998m, the drawdown is 9.93~74.82m, the unit-inflow is 0.092~0.098L/s·m, and the permeability coefficient is 0.13~0.14m/d, the degree of mineralization is 1.1~2.74g / L, water chemical type is mainly Cl·SO₄-Na, the aquifer is a rich aquifer.



Figure 2. The dissolution fissures of the Huanhe formation

(2) The lithology of the pores and fissures of the Luohe formation are mainly purple-red and brown-red medium-grained sandstones. The lithology of the middle and lower parts is mainly mudstone, and the Yijun formation conglomerate is generally missing at the bottom. Among them, the sandstone layer is relatively loose and has good water content. The mudstone section in the lower part of the Luohe formation is in direct contact with the mudstone layer of the underlying Jurassic Anding formation, as shown in Fig.3. The thickness of the formation is 124~525m, and the average thickness is 370m. The thickness of aquifer is 298~345m, the water level is 985.98~1024.88m, the depth is 9.65~36.0m, the unit water inflow is 0.52~1.45/s•m, the permeability coefficient is 0.11~0.35m/d, and the salinity is 2.62~5.71g/L. The types of water chemistry are mainly SO₄-Na, SO₄•Cl-Na type. During the construction process, the NZ314 hole in the Malian river valley and the NZ714 hole in the Jiulong river valley have experienced strong turbulent water inflow, with a water inflow of 240~260 m³/d, as shown in Fig.4. The NZ714 measures 42 meters above the ground, which is a richer aquifer.



Figure 3. The core of Luohe formation



Figure 4. The drilling water of Luohe formation

4. Groundwater recharge, runoff and drainage conditions

4.1. Weathering fissure phreatic of the Huanhe river

Groundwater recharge, runoff and drainage conditions are controlled by structural joint fissures. In addition to the recharge of atmospheric precipitation in the bare area, it mainly accepts the infiltration of the surface water and the upstream underground runoff in the valley area and the infiltration replenishment of the overlying loose layer phreatic. The Cretaceous weathered fissure belt, mainly accepting the surface water and upstream of the valley area. Lateral recharge of groundwater runoff and infiltration of overlying loose layer phreatic. The runoff and drainage conditions are consistent with the surface water flow, and the watershed moves to the valley. The overall runoff direction is transported from the upper reaches of the valley to the lower reaches, and the groundwater is drained into the valleys in the form of descending springs.

4.2. The early cretaceous pores, fissure confined water

The early cretaceous pores, fissure confined water accept subgrade recharge of the phreatic and infiltration replenishment of atmospheric precipitation in the eastern part of the area of Ziwuling and its eastward Fuxian, Huangling and other places. The infiltration recharge of precipitation is generally along the northeast-southwest runoff, and the runoff collection zone is formed in the Malian River and the intersection of the Malian river and the Weihe river. The cretaceous confined water is in the west of the Malian river, mainly in the cretaceous outcrop area of the Liupanshan area to the west of the exploration area. It receives the infiltration of the atmospheric precipitation into the infiltration, from the west to the east, in the area of the Malian river and the intersection of the Malian river and the Weihe river. The runoff collection zone is formed to be drained.

5. Conclusion

Longdong Ningzheng mining area is rich in groundwater resources, and The early cretaceous aquifer is the most important source of water for production and living in the region. The early cretaceous aquifer is divided into the weathering fissure phreatic of the Huanhe river and the cretaceous confined aquifer according to the stratigraphic sequence. The aquifers of the Huanhe formation are generally distributed in the region, with a thickness of 51~100 m, a buried depth of 3.73~53.6 m, and a water chemistry type of SO₄-Ca-Na-Mg. The phreatic mainly accepts the lateral recharge of surface water and upstream groundwater runoff in the valley area and the infiltration replenishment of the overlying loose layer phreatic. The lithology of the pores and fissures of the Huanhe formation is dark purple red siltstone, mudstone, sandy mudstone and fine sandstone. The aquifer thickness of the sandstone section is 60~90 m, the permeability coefficient is 0.13~0.14 m/d, and the water chemistry type is mainly for the Cl•SO₄-Na, the aquifer is a weakly water-rich aquifer, the lithology of the pores and fissures of the Luohe formation are mainly purple-red and brown-red medium-grained sandstones. The thickness of the aquifer is 298~345 m, the permeability coefficient is 0.11~0.35 m/d, and the hydrochemical types are mainly SO₄-Na, SO₄•Cl-Na. During the construction process, some boreholes appeared strong self-flowing water, which is a medium-rich water-rich water-rich aquifer. The Cretaceous confined water is recharged by the bedding recharge and atmospheric precipitation in the east. The cretaceous outcrop area in the Liupanshan area in the west accepts the infiltration of the atmospheric precipitation into the infiltration. The confined water is larger, but the general water quality is poor.

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