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Geological Structure of Hydrogeology and Environmental Geology

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Abstract: *In the current situation of rapid social and economic development in China, the research on the geological construction of hydrogeology and environmental geology is a relatively important core content. At present, China's geological exploration technology is also increasingly evolving, with various intelligent technologies emerging one after another and widely applied in geological engineering. The current engineering and mining construction should attach importance to studying the geological structures of hydrogeology and environmental geology, in order to make new contributions to the in-depth development of China's energy industry. Based on this, this article mainly discusses and analyzes the importance, technological advancement, current situation, main content, and geological structure of geological structure research in hydrogeology and environmental geology, in order to provide reference opinions for related engineering construction and innovation.*

Keywords: *hydrogeology, environmental geology, exploration technology, geological structure, exploration and analysis*

1. Introduction

Currently, various industries are moving towards modernization. The research on hydrogeology and environmental geology can not only adjust the economic structure reasonably, but also deeply promote engineering construction. In recent years, China has attached great importance to the exploration of hydrogeology and environmental geology. It has increased exploration efforts, innovated geological exploration techniques, and brought new development opportunities for the improvement of exploration level. The innovative development of hydrogeology and environmental geological exploration technology has gradually been applied to engineering construction, greatly promoting engineering construction. Especially in the field of mining mineral resources, relevant personnel should pay special attention to the research work related to hydrogeology and environmental geology construction, in order to play a more active role in promoting China's energy development and innovative application.

2. The importance and technological advancement of geological structures in hydrogeology and environmental geology

2.1 Hydrogeology

Technicians should investigate and analyze the groundwater resources and utilization within the area, and make reasonable utilization plan based on the actual situation of the exploration, and propose relevant suggestions on how to scientifically apply them.

At the same time, technical personnel also need to conduct in-depth research on whether the quality of groundwater in a certain area will have adverse effects on engineering construction. If there are adverse effects during engineering construction, how to provide targeted solutions based on the actual construction situation and regional water quality characteristics is important. In the current information age, with the improvement of engineering construction project requirements and construction standards, relevant national departments have refined hydrogeological research work to promote deeper exploration by relevant departments and personnel.[1]

Hydrogeology exploration work can be subdivided into sub disciplines such as regional

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hydrogeology, groundwater dynamics, hydrogeology of mineral deposits, and hydrogeology, with the in-depth development of hydrogeology, it will gradually penetrate and integrate with geothermal, seismic, and environmental geology, leading to innovative or interdisciplinary research in hydrogeology research.

2.2 Engineering geology

The discipline of engineering geology involves geological hazards, rock formation, and parameters, as well as stability and seismic aspects. In order to conduct in-depth research on engineering geology and obtain more reasonable results, it is necessary to provide important reference basis for the entire process of engineering construction through in-depth research on engineering geology in order to carry out engineering planning, geological survey, design and construction planning, and later maintenance.

Technical personnel should conduct thorough research on the engineering geological structure, scientifically survey the engineering construction environment, and provide scientific evaluation standards. Technicians need to observe and test the adaptability of the engineering geological structure and construction conditions in the area to see if they meet the construction conditions and pose safety hazards to the construction. At the same time, they also need to survey various geological conditions during the construction process and analyze the relevant geological data obtained.

Relevant personnel conduct comprehensive analysis and prediction of various geological data obtained, such as whether the geology of the construction area will be affected by external forces, and whether the geological structure conditions will change, in order to scientifically screen the construction site. When a certain geological structure data is found to be inconsistent with the construction standards, corresponding solutions should be provided in a timely manner to ensure the scientific nature of the engineering design and provide reference for engineering construction through scientific data.

2.3 Engineering projects

The reasonable advancement of engineering projects requires engineering quality improvement to provide services. If there are changes in engineering construction, the direction of engineering geological research should also be readjusted, and corresponding research methods should be adjusted accordingly. Relevant personnel should pay special attention to the study of earthquake occurrence conditions and the stability of surface rock masses, making it a key focus of geological research in engineering construction.

In the actual implementation process of the project, if there are special circumstances, in order to ensure the research effect, relevant personnel can use advanced instruments or advanced technology to deeply study some details, provide corresponding opinions and technical support for the overall implementation of the project to ensure the rationality, stability and progressiveness of the project construction.

2.4 Technological analysis

In the current era of technology, various fields are increasingly emphasizing the content of technology. Observing the current research directions of hydrogeology, engineering geology, and environmental geology in China, it is found that the integration of technological elements is also increasing. It is the inevitable direction and trend of current social development. For the study of geological structures in hydrogeology and environmental geology, it is also necessary to integrate scientific and technological elements. Technical personnel should actively integrate some scientific and technological elements.

In practical work, more advanced equipment and high-tech geological exploration levels can be introduced, and these technological elements can be closely related to government functions, hydrogeology, and environmental geology. Scientific exploration should be conducted in accordance with national laws and regulations, and geological structures of hydrogeology and environmental geology should be scientifically surveyed. Targeted measures should be taken based on actual survey data to better protect the ecological environment. In addition, practical factors should be introduced into the discipline to make hydrogeology and environmental geology important contents for the expansion and extension of the discipline, and provide important guidance and support for the research of overall geological conditions and structures, making technology an important force for innovative

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development.

3. Current situation of environmental geology, hydrogeology, and engineering geology in China

Although China's economy has made great achievements, its environmental geology and disaster geology are also very prominent, and there is a trend of gradually deteriorating development. At present, China attaches great importance to the rational allocation and development of water resources. Currently, groundwater resources in nature are becoming increasingly scarce, and water quality is also gradually declining. At the same time, there are also geological disasters such as excessive mining of mining resources, resulting in ground subsidence and seawater intrusion caused by the destruction of the natural ecological environment. As shown below, figure 1 is a picture of the seawater diagram.[2]In addition, improper use of land resources in economic development has led to serious environmental problems such as soil erosion, mudslides, and desertification, as well as various large-scale construction projects that can seriously disrupt the balance of the ecological environment.

In response to these practical situations, we need to recognize that while developing local economies, there is also a need to pay special attention to groundwater resources and geological environment issues, and conduct in-depth research on the aforementioned issues.

Firstly, for important economic development areas, key engineering projects, important transportation arteries, and key mining resource extraction, relevant departments should do a good job of supervision, scientifically control and reasonably develop groundwater resources, integrate regional water resources and environmental geological conditions, and achieve coordinated development, so as to gradually stabilize the crustal conditions in the region, and scientifically predict and prevent geological disasters in the region, it can maintain ecological environment balance and fully leverage the geological ecological environment effect, so that China's water resources can be scientifically and reasonably utilized, thereby further optimizing and improving the ecological environment, minimizing geological disasters, to serve China's economic development and ecological urban construction.

Secondly, a series of strengthened studies should be conducted on the geology--geochemical environment, biogeochemical characteristics, ecological effects, and system control within the region to provide more comprehensive services for human health and agricultural development.

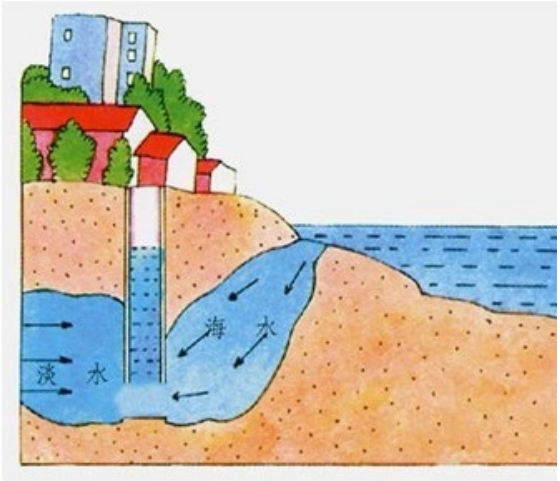

Figure 1: The seawater intrusion diagram

4. Main contents included in hydrogeology and environmental geology

4.1 Making the construction layout more reasonable

In the layout process of many engineering constructions, it is not only necessary to have good construction land, but also to have a relatively complete transportation system construction, such as housing and factory building construction, which needs to be fully considered in order to provide

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assistance for hydrogeological and environmental geological related investigations and lay the foundation for subsequent engineering construction. Based on this, relevant personnel should scientifically design the construction layout to significantly improve the quality of engineering construction. They also need to conduct on-site inspections of the hydrogeological and environmental geological conditions in the construction area, and use this as a basis for in-depth analysis to accurately predict the surface settlement situation during the construction period, and provide important basis for engineering construction. Relevant personnel also need to conduct investigations on the surface to ensure that there are no problems during the construction period and to improve the quality of the project.

4.2 Conducting scientific investigations into geological hazards

When technical personnel explored the hydrogeological and environmental geological conditions in various regions, they found that the most likely occurrence was geological disasters. On the surface, geological disasters such as earthquakes and mudslides often occur. After these surface geological disasters occur, they will pose a serious threat to people's lives and property. [3]Relevant personnel should conduct in-depth analysis of the surface conditions after on-site investigation, and accurately predict the geological disasters that will occur to urge the construction party to take scientific precautions and minimize the adverse effects of geological disasters.

Relevant personnel should conduct comprehensive analysis and summary of the data, and based on the final summary results, which covers geological conditions and other content, and conduct in-depth analysis from multiple dimensions, and develop scientific and reasonable preventive measures.

4.3 Conducting scientific investigation into water resources

In order to better carry out hydrogeology and environmental geology work, technical personnel should prioritize water resource exploration. At present, China is severely lacking in water resources, and the distribution of water resources in various regions is also very uneven. However, China's economic development is relatively pleasant, and the water consumption for people's daily life and production is increasing, leading to an increasingly prominent phenomenon of water resource shortage in China. At the same time, serious water pollution has also occurred in some regions. Relevant departments need to pay attention to the prominent problems of these water resources, continuously increase human and financial investment in water resource exploration and research and development, and continuously improve the quality of water resources to promote economic development.

In coastal areas, seawater intrusion often occurs, leading to land subsidence and seriously affecting the overall development of coastal areas. Based on this, relevant personnel need to strengthen the investigation of water resources, conduct in-depth analysis of the root causes of water pollution from multiple perspectives and scientific evaluation of hydrogeology, provide targeted improvement measures, and adopt more reasonable water supply models based on the actual application status of water resources in the region.

5. Hydrogeology correlation analysis

5.1 Regional hydrogeological conditions

For example, the lowest elevation in a certain mining area is 1320 meters, and the highest mountain level in the area is 1680 meters, with a difference of 360 meters. The area where the mine is located is a karst zone, and its hydrogeological conditions are very complex. Technical personnel conducted on-site investigations and predicted and analyzed the hydrogeological structure of this area. It was found that there were often sudden floods in the tunnels of this mining area, and the hydrogeological conditions were complex, but no obvious geological disasters occurred. There is a Longtou Mountain in the area where the mine is located, with a sloping hydrogeological unit on its back, which can be analyzed as an erosive shallow cut middle mountain area. It is often affected by aquifers, hydrogeological structures, and strata. At the same time, there are obvious secondary hydrogeological units such as underground strong runoff zones, dam anticlines, and dam synclines within the mining area.[4]

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5.2 Water-resisting layer and water-bearing stratum

The basic situation of the water-bearing stratum in the water source area of the mining area is shown in Table 1.

Table 1: Basic situation of aquifer of mining area

System Category		Lithological characteristics	Hydrogeological characteristics
Quaternary		The thickness is 0-12m, yellow sandy clay, with an unconformity contact angle with the underlying strata	Pore water-bearing stratum
Permian	Liangshan	The upper and lower parts are gray to black shale mixed with carbonaceous shale, generally 20m thick, sometimes interbedded with sandy shale	Water-resisting layer
	Qixia	The lower part is composed of black carbonaceous, gray black dark gray thin to medium thick layers of argillaceous limestone, and carbonaceous dense limestone; The upper part is a thick layer of gray dark gray block limestone	Karst water-bearing stratum
	Maokou	The thickness is 66-246 meters, with the lower part being a thick layer of gray light gray limestone and the upper part being a dense block of gray thick layer limestone	Karst water-bearing stratum
Liangshan		The lower part is dark gray black carbonaceous clay rock with inferior coal seams; The middle part is composed of sandy clay rock mixed with quartz sandstone and dark gray drill soil rock; The upper part is light gray medium thick dense block quartz sandstone	Water-resisting layer

5.3 The relationship between regional groundwater and the location of mining areas

(1) Groundwater recharge: The groundwater supply of this mine area mainly relies on mountainous areas. The precipitation condition in this area is good, however, the surface is often eroded by a large amount of rain, the forest coverage rate is not high, the mountain terrain is cut, and the precipitation is mainly rainstorm, so the surface discharge is greatly increased. There is not much surface water seeping into the ground, and most of the groundwater or surface water is recharged in the form of surface runoff.

(2) Groundwater discharge pathways: The groundwater in this area mainly includes industrial water, domestic water for the public, groundwater runoff, and evaporation and drainage.

(3) Location of the mining area: The location of this mining area is a regional hydrogeological unit, which is located in the runoff and recharge areas, and the ore body is located on the lowest erosion reference level within the internal gully.

6. Environmental geology correlation analysis

6.1 Overview of environmental geological issues

Environmental geology problems involve a wide range of aspects, including various types of environmental geological disasters that occur in nature, such as surface depressions, cracks, subsidence, soil erosion, and groundwater depletion. Relevant personnel should conduct in-depth research on these environmental geological problems, explore their causes, and take targeted preventive measures to improve these environmental geological disaster problems.

When conducting relevant research on environmental geology issues, technical personnel should fully explore and study these regional geological disaster problems, deeply explore the objective conditions, occurrence mechanisms, and development laws of their occurrence, and also fully consider the adverse effects of these environmental geological problems on people's lives. On the basis of on-site geological surveys, objective data should be obtained and analyzed in depth to provide targeted preventive measures. At the same time, it is necessary to conduct in-depth research on some issues of human induced environmental damage.

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For example, in the construction of projects, some improper operations have affected the surrounding geological environment, such as building channels, highways, tunnels, etc. Improper construction operations can also lead to phenomena such as mountain landslides and rock collapses. At the same time, some construction projects may involve excavation of sand and soil on the foundation and surrounding slopes, which may damage the geological and vegetation of the construction area.

6.2 Geological conditions of the mining area

(1) Geological structure: The construction of this mining area is relatively complex, most of which are fault block mountains formed by geological plate faults, bringing a large amount of magma and moving in the tectonic fault area, and under a large amount of activity, it will seep into the fault block mountains. For the scientific survey of the area, the following data parameters were obtained: The corresponding seismic basic intensity of the mining area is 6 degrees, the peak seismic acceleration is 0.05g, and the characteristic period of the seismic response spectrum is 0.35s. Based on these parameter data, it is proven that this mining area belongs to an area with weak seismic activity.

(2) Engineering geological and hydrogeological conditions: This mining area is generally composed of hard or semi-hard rocks, with a few areas being soft rocks. These rocks are very complete, and no active faults or weak interlayers have been found in this mining area. The groundwater in this mining area belongs to the Quaternary fissure phreatic water, with good water quality. The bedrock fissures are not highly water rich, and the fissures are directly in contact with the aquifer of the ore body. The fissure water enters the mine pit along the structural fault zone and weathered fissures, resulting in the phenomenon of deposit flushing.

(3) The type of environmental geology in the mining area: No pollution sources were found around the mining area, and the waste rocks and ores produced during mining cannot be decomposed into harmful substances. The overall geological environment quality of the mining area is good.

6.3 The impact on the environmental geology and land vegetation

During the mining process, the groundwater in this mine complies with national standards. The bedrock fissure water is at a high static water level and is located in a tectonic fissure swelling. The Quaternary pore phreatic water is distributed in low canyons. In order to prevent groundwater pollution, mining wastewater cannot be directly discharged. Mining units should purify and treat the wastewater generated during the mining process, and scientifically produce and discharge mining pit wastewater in accordance with relevant national standards to improve the water quality of the mining area.

In addition, a large amount of ore and slag are generated during mining in the mining area, which are disorderly stacked in the mining area, causing a serious impact on the surrounding environment and greatly affecting the growth and development of plants in the mining area. To change this phenomenon, it is necessary to stack these ores and slag in geological flat areas to promote ecological balance within the area.

6.4 The impact of mining

During the mining process of the mining area, it will have adverse effects on the water sources in the area. If the groundwater in the mining area drops below 120 meters due to mining, a funnel shape will be formed in the groundwater layer of the mining area, which will cause a large amount of groundwater to flow into the mining area, significantly reducing the surrounding water level, and also having adverse effects on residents' water use. At the same time, a large amount of slag is generated during mining. Improper treatment of these slag can cause harmful substances to seep into the surface layer under the action of precipitation, not only polluting the groundwater in the area, but also bringing pollution to the surrounding water environment. In addition, it has an impact on mining. The underground water-bearing stratum has the characteristic of high pressure. If there is abundant groundwater in the mining area, the groundwater level will rise during mining, and sudden water will enter the mine pit, which will seriously threaten the safety of relevant workers.

6.5 The impact of mine drainage on the surrounding water level structure

During mining, its drainage capacity is improving. When the groundwater level in the mining area is below 120 meters, a funnel shape will be formed in the surrounding water level area, and a large

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amount of groundwater will flow into the mine area. The surrounding groundwater level will also decrease, which will have a negative impact on the living water supply of the surrounding residents. At the same time, it will also seriously affect the water intake of the surrounding water plant, and even cause water cut-off, which will seriously affect the normal life of the surrounding people.

6.6 The impact of aquifers on mining work

When mining mineral resources, technical personnel should focus on actual exploration before construction, especially fully exploring the underground water-bearing stratum in the mining area, which has a great influence on improving the safety of mining. Due to the high pressure of underground water in the mine, if there is abundant underground water in the area, it may reach the groundwater level during mining, which can lead to water immersion in the mine and seriously threaten the safety of workers.

6.7 Effective countermeasures for groundwater problems in mines

Firstly, before mining, technical personnel should conduct on-site investigations to gain a deeper understanding of the geological and groundwater conditions within the mining area. The second is to do a good job in surveying and monitoring the slope of the surrounding mountains in the mine, and provide fixed support for high-risk mountain slopes to ensure mining safety. The third is to monitor the groundwater level and water inflow and outflow in the mining area to prevent direct subsidence of the mine surface. [5]The fourth is to strictly investigate the geological conditions inside the mine and conduct scientific monitoring and exploration based on the actual construction situation. In case of special circumstances, it is necessary to avoid dangerous areas to ensure the safety of mine construction.

7. Conclusion

In summary, for engineering project construction, conducting geological structure surveys for hydrological and environmental engineering is extremely important. Especially in the complex conditions of mining areas, it is easy to encounter situations such as hazardous factors, water pollution, and environmental damage. Therefore, in order to better carry out engineering construction and mining resource extraction work, relevant personnel need to conduct a detailed survey of the hydrogeological and environmental geological conditions of the construction area, analyze the relevant problems and identify the root causes of the problems, and then provide scientific and reasonable targeted prevention strategies, in order to minimize the series of negative impacts caused by hydrological engineering geological structure and environmental geological structure to the greatest extent, provide reference basis for engineering construction and mining resource extraction work, and make greater contributions to China’s energy reserves and economic development.

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