Research on the Application of Geological Forecast in Coal Mine Safety Production

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Abstract: In order to realize coal mine safety production, it is analyzed the importance of geological forecasting in coal mine safety production from three aspects: the close relationship between geological forecast and safety production, the guiding significance, and the occurrence of accidents. It applied successfully to three aspects: geological forecasting to fault prediction, outburst disaster prevention, and mining plan design. It is of great significance to the safe production of Shangzhuang Coal Mine.

1. Basic situation of the mine

Hangzhuang Coal Mine is a provincial state-owned medium-sized enterprise, which belongs to Jiangxi Coal Industry Group Co., Ltd. The mine’s approved production capacity is 0.45Mt/a. It mainly mines the B4 coal seam of the Longtan Formation of the Upper Permian System. The designed service life is 36 years and the remaining service life is 27 years (extended).

The mine is a multi-level development of inclined shafts. There are five existing shafts: main shaft, auxiliary shaft, skip shaft, east air shaft, and west air shaft. The skip well is used as the main hoist, the main inclined shaft and the auxiliary inclined shaft are used as auxiliary hoists. The main inclined shaft, auxiliary inclined shaft, and skip well enter air, and the east and west air shafts return air. The mine is designed to mine at four levels, the first, second and third levels (-110m, -230m, -450m) have been closed after mining, and the current production level is at the fourth level (-650m). The current production level has three mining areas, namely: east wing, central and west wing mining areas.

The mine adopts the strike longwall mining method, all the caving method manages the roof, and is equipped with a comprehensive mechanized coal mining face.

The mine has medium hydrogeological conditions and medium engineering geological conditions. It is a coal and gas outburst mine, and the B4 coal seam is an outburst coal seam, which is explosive and has a tendency to spontaneous combustion. The mine environment and geological conditions are complex, and the coal seams are greatly affected by faults.

2. Analysis of the importance of geological forecasts to safe production

2.1. Geological forecasts are closely related to mine disasters

In recent years, there have been many accidents in coal mines, causing heavy losses to the lives and property of the country and people. Summarizing the cause of the accident, in addition to some...
subjective factors, there are still situations that are insufficient understanding of the objective natural conditions and dangers ahead of the mining, and there is no awareness of precautions in advance to cause accidents. According to investigations and studies, coal and gas outbursts mostly occur near structures, where ground stress is concentrated and the thickness of coal seams varies greatly. Most of the roof collapse accidents are the areas where the roof rock is broken and the pressure is high. Water penetration accidents are directly related to hydrogeological conditions.

2.2. **Geological forecast can effectively guide coal mine safety production**
Geological factors are one of the important factors affecting mine construction and safe production. If the objective geological factors ahead can be targeted to foresee, the degree of harm can be provided to the leaders in advance to warn, and relative preventive measures can be taken to reduce or avoid accidents. Therefore, regular geological forecasts should be made during the production process, and temporary forecasts should be provided when necessary to guide the normal safe production of coal mines.

2.3. **Geological forecasting can effectively prevent accidents**
If you have detailed geological data, you should accurately grasp the nature of surrounding rock, faults, folds and coal seams of the roadway under construction before construction, and take corresponding measures in time. If actively preventing accidents in management and technology, it can effectively reduce and eliminate accidents.

3. **Application examples of geological forecast**

3.1. **Prediction and prediction of faults**
Doing a good job of meticulous geological foundation work is the prerequisite for accurately providing mine geological forecast. The main steps are as follows:

3.1.1. **Analysis of existing geological data**
First, it is necessary to collect and sort out the geological data revealed during the exploration and mine construction period. Then, it make an overall classification of the main structure distribution within the mine. Finally, it establish the structure type of the mining area and find the law.

3.1.2. **Establishing a ledger of geological structure maps**
First, it must to comprehensively and systematically measure, record, and sketch the geological structure and coal and rock change phenomena exposed by the shaft. Then, it should to fill in the mine geological comprehensive map and various structural accounts. It also ensure that the objective reality of the mine geological structure is truly reflected. This is the most important basic work of mine geology. Without this work, the data will not be comprehensive, and the content of the forecast will be prone to errors and cannot effectively guide production.

3.1.3. **Forecast and prediction of faults in 608 working face**
Due to the unknown geological data of 608 working face, it exists a group of normal faults with a drop of 4m through prediction, as shown in Figure 1. After digging tens of meters, the structure was revealed. Affected by the fault, the roof in this area was broken, making the 608 working face repositioned. It brings certain economic losses to the project and adds unfavorable factors to safe production.
3.2. Geological prediction and forecasting prevented outburst accidents

First, according to the mastered geological data, it find out the occurrence of geological structures and the characteristics of coal and rock changes. Then, it analyzed the existence, nature and scale of geological structures. For example, it predict the extension direction of the fault, the change of the coal seam, the size of the fault drop, and the location of the other wing coal seam. Finally, it rationally arrange the roadway and the direction and location of the tunneling.

Take the example of uncovering coal at Shimen 5012 air intake roadway. First of all, according to the geological data provided by the geological department, it is estimated that the tunnel excavation of about 10m will expose a group of large faults with H≈20m. Then, corresponding outburst prevention measures were taken in advance to fully relieve the pressure of the coal seams within the fault range. So as to effectively prevent the occurrence of coal and gas outburst accidents in 5012 air inlet tunnels.

3.3. Geological prediction and forecasting realize the precise design of mining plan

The prediction of geological structure is also important to the design of the scheme. It is of great significance to infer the layer relationship between the rock roadway and the coal seam based on the exposed coal seam elevation, and to formulate the mining plan. For example, the geological sketch map of 5012 advance measures (see Figure 2 for details) has realized the precise design of roadway excavation.
4. Conclusion

(1) Tt applied successfully to the geological forecasting at fault prediction, outburst disaster prevention, and mining plan design. It is of great significance to the safe production of Shangzhuang Coal Mine.

(2) Geological forecasting has significant social and economic benefits for the safe and scientific construction of coal mines, improving construction efficiency, shortening the construction period, avoiding accident losses, and saving investment.

(3) It should be done well in mine geological forecasting and a long-term mechanism should be established, so that geological forecasting can really play a guiding role in the mining process.

Fund Project
This work was financially supported by the national key research and development program of China (2017YFC0804206), General project of Chongqing Research Institute Co., Ltd (2019YBXM31), General project of Chongqing Research Institute Co., Ltd (2020YBXM22).

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