

Study on the Temporal and Spatial Effect of the Relief Pressure of Upper Protective Layer Mining

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Abstract. In order to study the law of pressure relief of upper protective layer mining. Through theoretical analysis and numerical simulation method, studied the distance on the protection layer mining floor stress field evolution and distribution, found a protective layer on the longwall mining goaf bottom coal seam inclination direction is concave, and strike plane was "O" shape of relief ball shell, the pressure relief angle in the cut or end mining line near the corner of the middle bottom is minimum, the scope of protection of coal seam pressure relief effect than on both sides of the pressure relief effect, namely the scope of protection of inclined coal seam central drainage radius than the two larger; in the trend of protected layer pressure relief protection layer mining face lag distance based on this theory, research to guide the protected layer of gas drilling drainage is very important.

Keywords. Protective layer; pressure relief; temporal and spatial effect

1 Introduction

With the increase of mining depth, coal and gas outburst disaster is more and more serious. The mining protection layer is the most economical and reliable regional measure to prevent and control coal and gas outburst. But in some mining area in the delineation of protected within and in the vicinity of the prominent, protection layer mining process in gas drainage mining technique is not perfect, cannot meet the needs of the production safety, of different gas geological and mining conditions of protective layer mining technology has yet to be combined with the actual situation of the research and improve. Therefore, it is of great practical significance to study the temporal and spatial effects of the mining of upper protective layer.

2 Project overview

Experiment site is in Qidong Coal Mine mining area two of 71 coal seam, mining area three of 61 coal seam, and lower section of two upper protective layer working face were not mining. 71, 82 and 9 coal seam were the main section of the mining area two, 81 coal seam was locally recoverable coal seam. 61, 71, 82 coal seam were the main section of the mining area three, 63, 72, 9 coal seam were locally recoverable coal seam. The 7122 working face is in no danger zone. The 82 and 9 coal seams were serious outburst coal seams, the average coal thickness is 2.3m and 2.65m, the average dip angle is 12 degree and 16 degree, and the 61 coal seam has no danger. 7122 working face with a comprehensive mechanization to the long wall back type mining, Fully caving method. The basic situation of the two and three mining area test face (Table 1, table 2).

Table 1. Basic situation of working face.

working face	elevation (m)	wide (m)	lone(m)	The thickness of coal seam (m)	dip angle (°)
6136	-498.6~-584	158	908	1.93	13
7122	-460~-500	164	1090	1.75	13

Table 2. Coal seam spacing.

Mining area two	coal seam	63	71	81	82	9	
	Layer spacing /m	13-36	11-25	7-11	6-21		
	Average interval /m	24	20	10	10		
Mining area three	coal seam	61	63	71	72	82	9
	Layer spacing /m	15-21	20-31	0-8	23-33	8-16	

	Average interval /m	19	22	3	27	11
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3 Influence zoning law of upper protective layer mining

The evolution and distribution law of the bottom of upper protective layer surrounding rock stress field, fracture field and gas flow field were the important theoretical basis of coal and gas coordination mining for high gas outburst coal seam group, stress field evolution, distribution is the prerequisite and determinants of fracture field and gas flow field evolution and distribution, according to the relevant theoretical research, longwall inclined and gently inclined coal seam mining influence range of stress variation partitioning and zoning division (Figure 1).

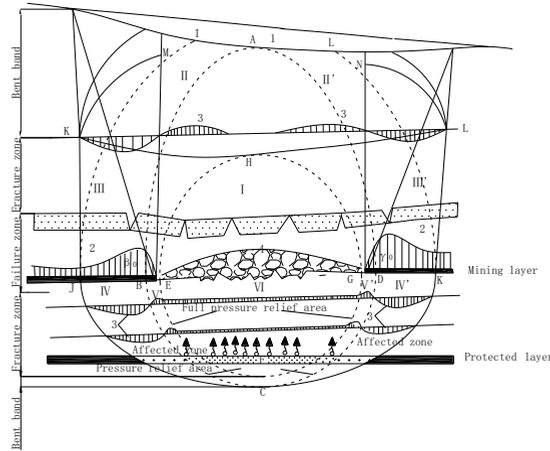


Fig.1. Schematic diagram of the influence of the internal stress in the mining area.

4 Numerical simulation analysis of protective layer mining

4.1. Evolution law of stress and displacement of bottom plate of upper protective layer

(1) Direction stress and displacement variation law

According to the actual conditions of the upper protective layer 7122 working face and its bottom coal seam, a 3-D numerical simulation model is established. To simulate 71 coal seam mining nowadays cover protected space of 82, 9 coal seam unloading pressure law more in line with the actual situation, the simulation distance protection 7122 working face, taking into account the overlying 61 coal seam working face mining pressure relief effect. Using ANSYS three-dimensional numerical simulation of protection layer mining protective layer was unloading pressure distribution and take protective layer of 71 coal seam calculation model to 100m in length and 7122 working face mining, the coal floor strata should stress and displacement changes(Figure 2).

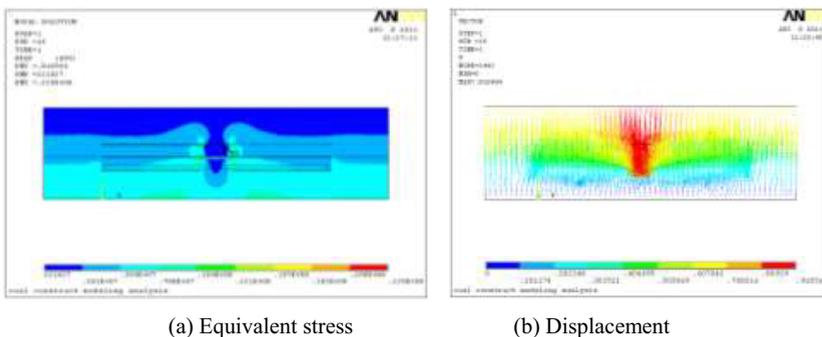


Fig.2. The evolution law of stress and displacement along the direction of the bottom coal seam.

From Figure 4 it can be seen that 7122 working face mining, bottom unloading pressure force and displacement isoline in elevation along the cut hole and end mining line exponentially (but curvature) to shrink, namely the facade unloading

pressure isoline is concave pressure relief ring, plane O-shaped unloading pressure ring and the theory on shrinkage regularity; the roof unloading pressure force and displacement isoline and the bottom plate are similar to the distribution of the.

(2) The law of stress and displacement variation

Take the protective layer 71 coal seam calculation model to the length of 180m, 7122 working face mining, the stress and displacement of the floor coal seam (Figure 3).

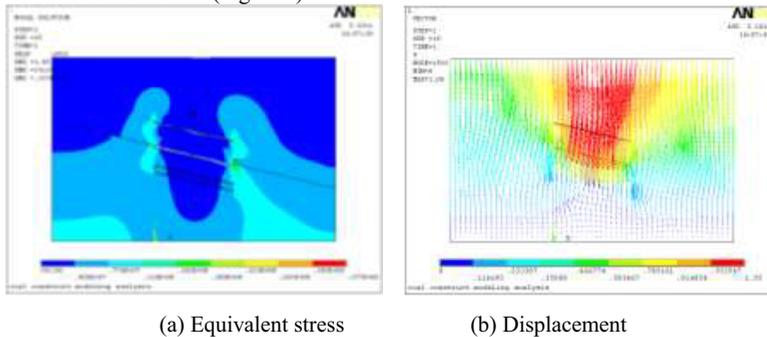


Fig.3.The evolution law of the stress and displacement of the coal seam in the bottom plate.

The stress field and displacement distribution of the bottom plate of the upper protective layer mining in the direction of the trend, the tendency of the stress field and the displacement distribution is a concave relief ring on the face of the face, and the equivalent line is "O". In order to provide theoretical support for the protective effect of the protective layer and the reasonable parameters of the gas drainage borehole layout.

5 Analysis on the pressure relief space of the protective layer in the middle and far distance

(1) According to the two mining area of Qidong mine protection layer mining working face 7122 spatial distribution characteristics and regularity of stress, lowering the pressure relief angle by 10% in the ground stress, in theory, the range of pressure relief gas drainage of protected layer is provided.

"O" ring close to the protective layer plane reaches the maximum value, and with the increase of the interlayer spacing of gradually decreasing trend, whether it is in the work surface or above the work surface below show the same rules. This is closely related to the evolution law of the pressure relief angle of the protective layer. When the distance protection layer face nearer, "O" ring relatively complete, but is relatively narrow, with the distance increase "O" ring the pressure relief effect gradually weakened, and its width it increased.

In order to reduce the equivalent of 10% of the equivalent line as a benchmark, the results obtained from the numerical simulation of the protective layer to remove the hysteresis of the coal mining face distance y and the distance between the X layer(Eq.1):

$$y = 16.7 \ln x - 37.2 \quad (1)$$

(2) Floor space pressure relief law

Floor strata due to stress lifted Poisson effect, near the floor strata pressure relief, level and vertical direction of fractured formation; mined out area at the top caving rock compaction, around goaf area there is still space, "O" - shaped pressure relief ring is formed, protect layer mining unloading pressure angle in the cut hole or terminal mining line near the corner is at a minimum.

7122 after the protection layer mining, the coal and rock mass compaction is more and more obvious, and the coal and rock mass around the mined out area is subjected to tensile action, resulting in a large number of cracks, and there is no compaction, the plane formed a "O" shaped ring.

7122 protective layer working face into the airways and return air lane, cuts the eye or terminal mining line near the corner corner should stress gradient is the largest, in the center of the work surface should be gradient force is relatively small, the corresponding upper and lower strata of the unloading pressure range is relatively small. Therefore, protective layer mining protected layer pressure relief protection angle in the plane is not the same everywhere, close to the protective layer working face of the central region is relatively large, close to the protection layer face cut eye and mining terminal line near the smaller. And production is protection layer face, return air lane must be arranged in a line, therefore, from the point of view of safety protective layer unloading pressure angle should be determined with protection layer face cut eye or terminal mining line near the corner of the minimum pressure relief angle as a benchmark.

6 Experimental investigation

Construction wear layer drilling in bottom pumping lane drilling field 10, drainage pressure relief gas of 9 coal seam inclined top, to investigate the gas drainage volume before and after pressure relief. When the 10# drill field distance protection layer working face 40~60m, gas drainage and extraction in drilling field reduce, drainage volume in 0.01~0.02m³/min, mainly by advance abutment pressure influence and protected 9 coal seam permeability reduced. Protection 7122 layer of work across the 10# investigation drilling field protective layer gradually been fully discharge pressure, gas drainage amount increases gradually, over 10# investigation drilling 30m near, gas drainage of it reached 0.28m³/min, then gradually decay; 7122 working face to advance to the 160m and protected 9 coal seam bottom drainage roadway gas drainage stability in the volume of 0.02m³/min (Figure 4).

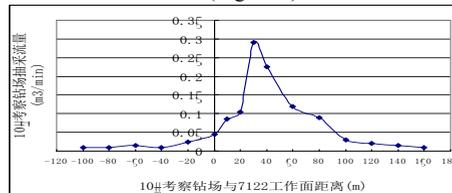


Fig. 4. Relationship between the gas drainage amount and the position of the 7122 working face.

Therefore, in medium or long distance protected floor rock roadway lag protection layer mining working face a certain distance construction crossing boreholes instant extraction to solve the traditional protected floor rock roadway wear layer drill gas drainage of the existence of drilling grouting hole, a clamping drilling, borehole outburst and dynamic pressure of mining damage caused by drilling leakage, coal hole hole collapse significant security risks.

7 Summary

Research on the theory and practice show that the protective layer of long wall mining at the bottom of the coal rock inclined direction concave, to the plane was "O" shape the discharging pressure spherical shell, protective layer and the protected layer spacing is larger, poorer protective effect, protection range is small, remote protective layer discharge pressure and gas flow lag protection layer mining working face certain distance of spatio-temporal relations.

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