Knife Handle Working Face

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With the rapid development of the social economy, the demand for coal is also increasing. Due to large-scale mining in shallow areas, coal resources are being increasingly depleted. Coal mines are gradually being mined in deep areas. Due to the complexity of coal seam conditions and variability, in order to reduce the loss of coal resources and the amount of moving, and to ensure the efficient mining of mines, the knife handle-type working face came into being. The complex overlying rock structure after the mining of the knife handle-type working face has brought great difficulties to the control of the surrounding rock of the working face.

knife handle working face   stress distribution   energy evolution

1. Introduction

Domestic and foreign scholars have conducted a large number of studies on the overlying rock structure and energy evolution rules after mining in the working face. Zhao Tongbin et al. studied the dynamic evolution law of stope support pressure through the ANSYS 19.0 software [1]. He Jiang et al. analyzed the distribution and evolution law of surrounding rock stress by establishing a numerical model and a surrounding rock mechanical model, and proposed a roof-type impact rock pressure mechanism [2]. Mou Zonglong et al. used UDEC 5.0 software to analyze the impact of roof rock layers of different thicknesses and strengths above the coal seam on coal mass impact from an energy perspective [3]. Cui Feng et al. used physical simulation and numerical simulation to analyze the structural evolution of the overburden and the characteristics of the mine pressure after mining, and divided the overburden impact risk area [4]. Wang Xinfeng et al. reflected the dynamic migration characteristics and mechanical response mechanism of the roof by analyzing the deformation effect and stress distribution of the continuous dynamic rupture of the beam on the internal coal and rock [5]. Pu Hai et al. analyzed the influence of mining depth and key layer breakage on the surrounding rock support pressure [6]. A.M.Suchowerska et al. analyzed the vertical stress distribution characteristics of the ultra-long working face, revealing the angular correlation between the vertical stress of the coal pillar bottom plate and the supporting pressure [7]. Dou Linming et al. theoretically studied the energy and stress conditions of impact mine pressure induced by the superposition of dynamic and static loads, and systematically proposed the principle of impact mine pressure induced by the superposition of dynamic and static loads [8]. HE Jiang et al. believed that when the hard roof breaks, the breaking stress is transmitted to the mining coal seam and generates a stress increment on the lower load-bearing coal and support. In severe cases, it can induce the occurrence of shock mine pressure [9]. Cao Anye et al. summarized the current status of mine earthquakes, and systematically elaborated on the research progress and main problems in the mechanisms, damage effects, prevention, and control technologies of mine earthquakes [10]. Jiang Fuxing et al. proposed the disaster mechanism of "creep type" rockburst accidents based on the study of the occurrence mechanism of

mining rockburst accidents in high-stress areas [11]. Nan Li et al. studied the fracture instability mechanism of hard roofs through physical similar simulations, revealing the "shear fracture at both ends—bending deformation in the middle—tensile failure in the middle" of the hard roof under in situ stress and mining stress [12]. Pan Junfeng et al. conducted an in-depth study on the evolution process of geoburst and proposed the theory of geoburst initiation [13].

Existing roof-weakening methods mainly include roof presplit blasting, frosted jet axial roof cutting, and directional long-hole segmented hydraulic fracturing to relieve pressure on the roof. Zhao Shankun proposed the synergistic anti-collision mechanism of a deep-hole roof presplitting blasting stress structure by analyzing the stress field of blasted rock mass, the plastic failure zone, and the stress and displacement change rules under different blasthole arrangements [14]. Chai Jiamei aimed to resolve the problem of coal SC in the goaf of an "isolated-island" fully mechanized caving face; a multiphysics model coupled with a gas flow field and a gas concentration field was established in the present study, and an accurate division of spontaneous combustion (SC) zones in the goaf and the determination of the prediction system of the SC index are developed [15]. Igor Ivanovich Bosikov developed a generalized expression for the transfer functions of coalmine objects, taking into account delays, and carried out the method for managing the process of changing connections between devices (controllers–switches) of the technical system [16]. Zhao Xinglong analyzed the basic rules of shear failure and tension failure of natural fractures caused by hydraulic fracture disturbance stress, and revealed the development and formation mechanism of natural fractures during hydraulic fracturing [17]. Grant A G et al. studied the effect of water content on different rocks. The influence of acoustic parameters provides a basis for research on the disaster precursor characteristics of coal and rock energy field distribution caused by water injection [18]. Pan Junfeng et al. proposed a A method of directional presplitting, pressure relief and anti-rockburst of water jet prefabricated slot in hard roof is presented and field test is carried out. The implementation area effectively reduced the stress level of the tunnel's surrounding rock [19]. Tang Shibin et al. studied the fracture initiation and propagation process in the rock fracturing process by numerical simulation [20][21]. Yang Junzhe et al. studied the fracture characteristics of the thick hard roof's overlying rock, proposed the dynamic disaster mechanism induced by the superposition of dynamic and static loads, proposed the advanced weakening treatment technology of hydraulic fracturing for the hard roof, and evaluated the pressure relief effect [22].

2. Engineering Background

Kuangou Coal Mine is located in Queergou Town, Hutubi County, Changji Prefecture, Xinjiang. The mine field is 70 km southwest of Hutubi County. The mine field area is about 20.1325 km^2. The main coal seams in the mine from top to bottom are the B4-1 coal seam, B2 coal seam, and B1 coal seam. The I010206 working face is located in the B2 coal seam in the east of the No.1 mining area. The uniaxial compressive strength of the B2 coal seam is 26.34 MPa, the average dip angle of the coal seam is 14°, the thickness of the coal seam is 8.6~20.8 m, and the average thickness is 9.5 m. The roof of the B2 coal seam is mainly composed of fine-grained sandstone and coarse-grained sandstone, with an average thickness of 15.7 m and a uniaxial compressive strength of 115.25 MPa. The floor of the B2 coal seam is mainly mudstone and fine-grained sandstone; the average thickness is 4.0 m and the uniaxial

compressive strength is 39.73 MPa. The appraisal results of the impact tendency of the B2 coal seam and the roof and floor strata show that the roof strata have strong impact tendency and the B2 coal seam and floor strata have weak impact tendency.

The open-off cut of the I010206 working face is 55 m away from the mine field boundary, the I010202 gob in B2 coal seam is on the north side of the I010206 working face, 15 m protective coal pillars are reserved for the I010206 working face and I010202 working face, and the upper 50 m of the I010206 working face is the I010408 working face in the B4-1 coal seam; the B1 coal seam is 25 m from the lower part of the I010206 working face. The first section of the I010206 working face is 85 m wide, the second section is 137.8 m wide, the recoverable strike length is 1672 m, the coal seam thickness is 9.5 m, the mining height is 3.2 m, the top coal caving thickness is 6.3 m. **Figure 1** shows the layout of the I010206 working face, and the red is the I010408 working face in the B4-1 coal seam; blue is the I010202 gob and the I010206 working face in the B2 coal seam.
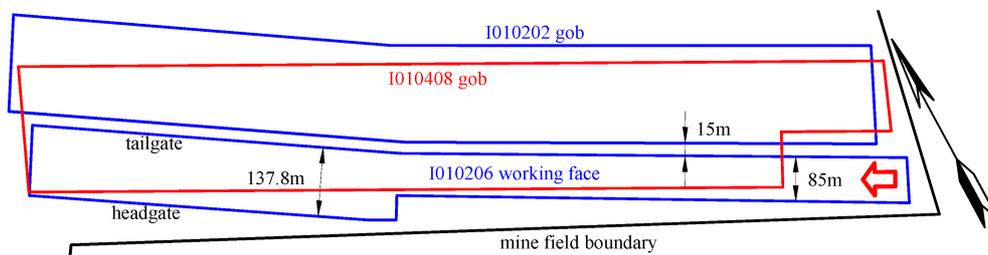

Figure 1. Layout of I010206 working face.

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