Study on Strata Behavior Law and Support Adaptability in Fault Island Pillar Light Caving Face

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Abstract

According to the geological conditions of coal seam and the specific circumstances of the roof and floor in 2123 fault island pillar light caving face of Shigejie mine, this paper studies strata behavior and fault disturbance in 2123 face. Research results show that weighting features in fault island pillar face under stress concentration are still is periodic weighting, pace distance from 14.5-18m, average 17.1m, but weighting strength is not big, average dynamic load coefficient is 1.23. Supporting parameters of ZFQ2500/16/24 type light fully mechanized top-coal caving support are reasonable and has better adaptability in 2123 fault island pillar face. Analysis and research on strata behavior and control technology of fault island pillar light caving face supply reference for similar mining conditions.

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Keyword: island pillar, light caving face, strata behavior law, light powered support, adaptability of support.

1. Introduction

The north of 2123 face is the goaf of 1303 face, the south for the goaf of 1302 face, the west for the border of mine, isolated coal pillar for 30 m, the east for 2119 face in Shigejie coal mine of Lu'an Mining Group, Shanxi province. Thus a typical island pillar face is formed, stress is very concentrated. NO.3 coal seam occurrences stability, coal seam thickness is 6.50 to 7.10 m, with an average thickness of 6.60 m;
coal seam dip is 4° to 7°, with an average of 5°; consistence coefficient \( f \) of coal seam is 1.5 to 2, mid-hard coal seam; coal seam depth is 260 m. Main roof of coal seam is gray medium-grained dense sandstone, the thickness of 6.53 m; immediate roof is sandy shale, the middle clip with sandstone, the thickness of 8.02 m; false roof is clay shale, easy to take off, the thickness of 0.02-0.10 m; immediate floor is hard sandstone, local with sandstone and shale, the thickness of 1.76 m; main floor is gray and black dense shale, the thickness of 3.00 m[1-3].

Based on systematic monitoring and analysis on strata behavior of the 2123 face, the author knows and masters working resistances of light support in fully mechanized top-coal caving face of No.3 coal seam, Shigejie coal mine, ensures distance, strength, support load distributing feature, and working resistance distribution and variety regulations of first weighting and periodic weighting in face, evaluates adaptability of light powered support in fault island pillar light caving face. Fault island pillars are successfully recovered using light support control technology and get safe operation and consistent production, that will supply reference for similar mining conditions[4-8].

2. Measured Analysis of Strata Behavior Law in Face

In 2123 face, the shoring resistance of supports are observed by KBJ-60[I]-1 mine digital pressure gauge, continuous observation load change of supports in face during mining, observation distance is greater than 60m (namely after three periodic weighting), analyze adaptability of light top-coal caving support and underground pressure in face based on these[9,10]. There are 65 supports fixing in face, and 5 stress observation stations, set respectively in no. 14 group, no.24 group, no.34 group, no.53 group, no.57 group above head-piece. Each station installs 2 mine digital pressure gauges, respectively in the front and back of pillar. Data are collected every five days in face.

Analyzing pressure changed curves obtained by actual measurement from 5 monitor stations in fully mechanized face, the author arranges and collects during the entire underground pressure monitoring period, setting loading, working resistance and maximum resistance of supports. Statistical analysis results of support working resistance are Table 1 in 2123 face.

Table 1 Statistical analysis results of support working resistance in 2123 face( unit: KN/support)

<table>
<thead>
<tr>
<th>Item</th>
<th>No. 14 group</th>
<th>No. 24 group</th>
<th>No. 34 group</th>
<th>No. 53 group</th>
<th>No. 57 group</th>
<th>Average value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average setting loading</td>
<td>1415.44</td>
<td>1298.83</td>
<td>1066.92</td>
<td>1453.71</td>
<td>700.83</td>
<td>1187.146</td>
</tr>
<tr>
<td>Average working resistance</td>
<td>1745.16</td>
<td>1620.65</td>
<td>1423.77</td>
<td>2011.94</td>
<td>846.21</td>
<td>1529.546</td>
</tr>
<tr>
<td>Maximum setting loading</td>
<td>1915.45</td>
<td>1760.13</td>
<td>1589.33</td>
<td>1898.94</td>
<td>825.47</td>
<td>1597.864</td>
</tr>
<tr>
<td>Maximum working resistance</td>
<td>2108.74</td>
<td>2123.48</td>
<td>1953.23</td>
<td>2360.94</td>
<td>955.98</td>
<td>1900.474</td>
</tr>
</tbody>
</table>

Fig. 1 Distribution histogram of support setting loading and working resistance along face direction

![Setting loading and working resistance](image)
Supports working condition: the distribution of setting loading of supports is intensive, setting loading about 1000-1500KN account for 80%; the distribution of working resistance of supports are mainly between 1500-2100KN, which account for 60% of supports observed; average setting loading accounts for 61.5% of yield setting loading, average working resistance is 60% of yield working resistances, maximum working resistance 2479KN/support observed is 96.9% of yield working resistance 2558KN/support. These indicate that the parameters of the support satisfy the requirements of this face supporting.

The performance characteristic of supports in face is main mild increase in resistance, average weighting dynamic load coefficient is 1.23, this illustrates that roof stress intension is small, cushion function of top coal and 8m thickness immediate roof buffer roof weighting.

3. Analysis on Stability and Reliability of Supports

ZFQ2500/16/24 type light low-position top-coal caving powered supports are used in 2123 mining face, main technology parameters are as follows.

Setting loading:1932KN; Setting loading of prop: 483KN; Working resistance: 2558KN; Working resistance of prop: 639KN; Support strength: 0.50Mpa; Drag force: 264KN; Maximum floor specific pressure: 1.56Mpa; Supporting height: 1.6-2.4m.

The observation on the spot shows that the supports chose show great adaptability to the production and geology condition in face. Main character show in the following respects.

(1)The supports in face run in a good state. It shows that setting loading of supports is similar to working resistance. The average setting loading of No.14 group supports is 1415KN/support, accounting for 81.1% of average working resistance(1745.16 KN/support); the average setting loading of No. 24 group supports is 1298.83KN/support, accounting for 80.1% of average working resistance(1620.65 KN/support); the average setting loading of No.34 group supports is 1066.92KN/support, accounting for 74.9% of average working resistance(1423.77 KN/support); the average setting loading of No.53 group supports is 1453.71KN/support, accounting for 72.3% of average working resistance(2011.94KN/support), the average setting loading of 57 group supports is 700.831KN/support, accounting for 82.8%of average working resistance(846.21KN/support).

(2)The average maximum working resistance actual measuring is 2011.94KN, and maximum displacement of supports active column is 200mm, these illustrate that the working resistance of supports and support strength have more than the need. Working resistance and utilization ratio of supports adapt to roof pressure, safe valve opening did no happening during the mining period, the run, fall, drop and leakage problems of support rarely appear, supports working is in good condition.

(3)During the mining period in 2123 face, supports adapt to island pillar’s roof movement rule under stress concentration, its support parameters are satisfied roof control and maintenance requirement, these demonstrate that this type of light powered support is suitable for specific roof circumstances of the in Shigejie coal mine.

4. Conclusions

(1)The distribution of Maximum working resistance is in areas affected by fault in middle top of face, rib spalling of coal wall and roof break are serious nearby fault, the main reason is the influence of secondary stress field induced from fault and the cantilever beam structure formed from roof break.

(2)Weighting features in fault island pillar face under stress concentration are still is periodic weighting, pace distance from 14.5-18m, average 17.1m, but weighting strength is not big, average dynamic load coefficient is 1.23.
(3) Supporting parameters of ZFQ2500/16/24 type light top-coal caving support are reasonable, it shows great control result towards special roof in thick immediate roof and has better adaptability in 2123 fault island pillar face.

(4) ZFQ2500/16/24 type light top-coal caving support completely meets the need of thick coal seam mining with special roof in Shigejie coal mine, can be used in other pillar mining of upper coal.

References


