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ANALYSIS AND REMEDIATION OF ENDOGENOUS FIRE AT LONGWALL TOTAL COAL THICKNESS MINING OF THE MAIN COAL SEAM IN RASPOTOČJE MINE OF ZENICA BROWN COAL MINES

Jelena Marković[1], Refik Kurbašić [2], Zvjezdan Karadžin [3], Edisa Nukić[4]

ABSTRACT

Mining of the thick coal layers that include roof caving operation can results in residual coal quantities in the gob as a potential threat causing occurence of spontaneous oxidation process, smoldering, and endogenous mine fire that can affect the safety and regular mine operations.

Endogeneous fire occurences in Zenica coal mines are directly linked to complex natural conditions reflecting in complex geological conditions, great depth of mining, high methane content in coal seams, and tendency of coal to spontaneous oxidation process.

The subject of the paper is the analysis of endogenous fire supression method applyed in conditions of complete coal thickness longwall mining in Raspotočje mine, that has been rehabilitiated upon the endogeneous fire and then reactivated. The following methods were used in fire fighting: passive fire fighting methods (sealing of the area affected by the fire), active method (injection of electrofilter ash) and ventilation methods. Furthermore additional data (position of gob area and sealing objects, air flow regulators, routes of possible air migration, suggested technical solutions, etc) were added in the linear and canonic schemes for the purpose of defining efficient solutions for fire fighting.

Key words: endogenous fire, longwall mining, advancing mining, fire fighting.

1. INTRODUCTION

Mining method applied in Zenica coal mines include caving of roof into the mined out area, without stowing-filling of voids created. Consequences of such a mining method result in increased flow (migration) of air through the gob of the longwall face, that is very dangerous from the point of fire hazards [2] [4]. These air migrations occur in the peripheral zones of mined out areas toward the safety pillar and unmined parts (along the workings and starting room- start line of the longwall face), and the parts immediately behind the longwall face, where a certain phase of final consolidation is taking place (roof caving, crushing of the roof, roof breakage, elastic deformation of the roof) [1] [5].

Volume and quantities of migrating air depend of inner and external difference in pressure potentials, resistance along the migration routes, area of the mining panel, mining web height, depth of workings, geomechanical rock properties in litostratigraphical column and ground tectonics in the mining zone. In the working panels when mining was conducted in roof plates of the main coal seam (GUS) a contact was made with the gob areas of the previous overlaying mining panels, resulting in air migrations, that were very dangerous from the point of possible fire occurences [2] [3].

[1]University of Tuzla, Faculty of Mining, Geology and Civil Engineering, jelena.markovic@untz.ba
[2] Full professor, Association-FUZIP-e, Sarajevo, Bosnia and Herzegovina
[3]Associate professor, University of Tuzla, Faculty of Mining, Geology and Civil Engineering, zvjezdan.karadžin@untz.ba
[4]Associate professor, University of Tuzla, Faculty of Mining, Geology and Civil Engineering, edisa.nukic@untz.ba

Mining in two working panels in the fourth tectonic block of the Eastern part of VII mine terrace , was conducted in the period October 1999-May 2005 using longwall-sublevel mining method. Two endogenous fires occured in that period in the gob area of the longwall face, one when the advancing, and one when the retreating mining system was apllied. This paper deals with the analysis of the endogenous fire in panel where advancing mining system was applied.

2. WORKING CONDITIONS IN MINING PANEL

Complete coal thickness mining of the Main coal seam (GUS) in two working panels in the fourth tectonic block of the VII mine terrace, was perfomed using longwall-sublevel mining method. The coal from the roof part was caved down, without blasting, initiated by colapsing of the coal console when the self-powered hydraulic support was moving forward [8]. Applied method of total coal thickness mining is shown in Figure 1.

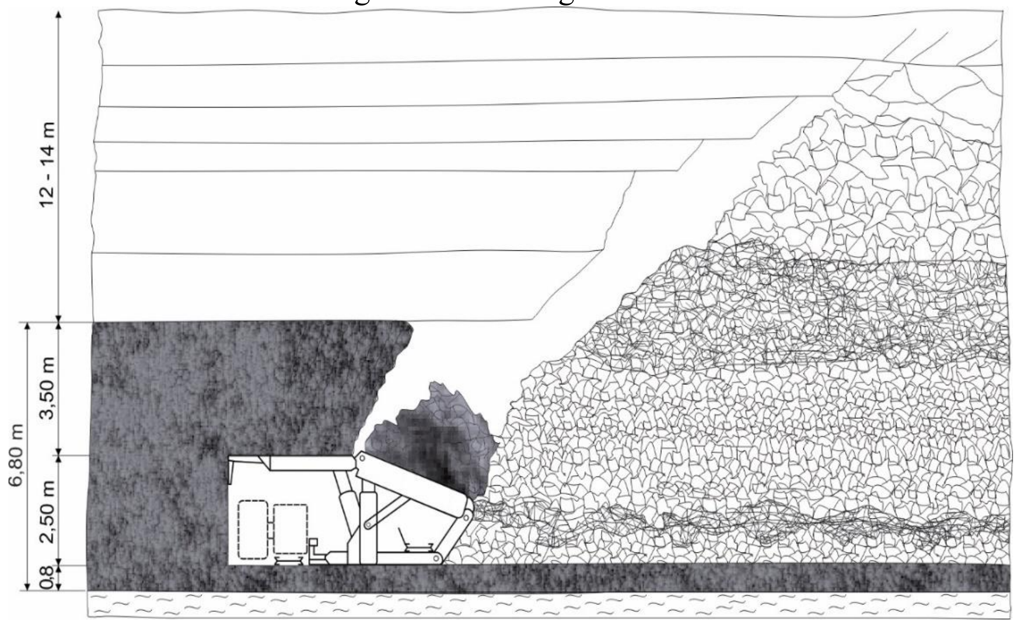

Figure 1. Total coal thickness mining of the Main coal seam in Raspotočje mine using „Sublevel“ method with Dowty 4000 self-powered hydraulic support [8]

Main parameters of the working method geometry [8]:
- length og the longwall face.. 75,0 m,
- total web height...5.5-6.0 m,
- level part...1.8-2.5 m,
- roof part..3.5-4.2 m,
- protection plate in the floor..0.5-1.0 m,
- productivity...........aprox. 8.0 t/m^2 or 550.0 t/m′ of face advance.

Yield/recovery of the total Main coal seam thickness was aprox 80 %. Losses of coal (aprox. 20 %) account for the protection coal plates left in the floor partion toward the marly-clay floor, and losses of coal at the opening for roof coal drawing at the final prop of the self-powered hydraulic support (SHS) , that at the 1 m from the floor coal plate create a plane of crushed coal in the caved material (in the gob area of the longwall workings). These losses, giving the propensity of main coal seam to spontaneous oxidation, present a constant threat for occurences of endogenous fire in the gob area of the longwall working panels. The special danger for occurences of primary fire ignition spots, present the crushed coal fines that remain in the floor plate, upon the passage of the longwall face. Removal of this coal in the space between the conveyors is difficult due to the closed construction of the support units.

Ventilation

Ventilation system of the mine active part (TB-IV, VII terrace of the Eastern part of the mine), is a very complex system, with a gob of the working panel G-VII-i-4/1 placed with the parallel, whose lateral present ventilation incline VU-114 from one side, and total ventilation system of the active workings, on

the other side. Ventilation corridor for the next panel VX-207/1 that is currently being prepared, present a diagonal between the laterals and closes the gob from the lower (eastern) side.
Ventilation air for the active workings is introduced by the main ventilation network through the short eastern connecting drift (KIP) to the entrance of TB-IV, where the lateral lines of the paralel system were created, while one part of the intake air was separated into the mine return air via short connection across the corridor to K 4,0 m. The first part of the lateral line VU-114 served to ventilate TS „F“, while the other part of the lateral line served to take out the return air from the workings for the workings on a new part of VH-207/1. The other lateral line serves for ventilating active workings in block TB-IV, chamber workings and development workings for chamber panels, longwall face and workings on drivage of ventilation corridor VH-207/1. Figure 2 shows a linear ventilation scheme of VII teracce of the eastern part of the mine (Block TB-IV) before closure of longwall workings required to supress the endogenous fire.

Sealing of gob area

Sealing of the longwall workings gob area was conducted using 4-12 m long so called mud plugs (hydraulic stowing) made of fine electrofilter ash. Sealing objects that close the gob area in the western side from the ventilation incline VU-114 (MČ 69 and 70) were constructed in length of 10 meters in the floor part of the Main coal seam (GUS). Gob sealing in the lower (southern) side from the ventilation corridor VH-207/1 were carried out with 4-5 m long mud plugs, no 208/1, 208/2, 208/3 and 208/4.
Mud plugs no.208/5 and 208/6 that closed the gob area from the transport corridor TH-208, that were additionaly reinforced with barriers covered with cement mortar, were constructed in the lower part of the connecting rise VU-208/5 and VU 208/6, at distance of 5-6 m from the transport corridor TH-208. Sealing in the upper (northern) side from the ventilation corridor VH-205 was carried out using 5-12 m long mud plugs mainly constructed in the roof layers of GUS (corridor drifted through the fault zone) marked as MČ: 205/1, 205/2, „05/3, 205/4, 205/5, 205/6 and 205/7.

Longwall face advance

DAWTY 4L-4000 kN self-powered hydraulic support with accessory equipment, was installed in working panel G-VII-i-4/1 in October 1999. Longwall face advance rate was aprox 21 m/month in two months period. In the year 2000 the average advance rate was 23.5 m/month. Advanced rate slowed down in 2001 to 18.75 on average. Sudden slow down in advance occured in the second half of the year when the advance rate was 15.8 m/month. Advance longwall face rate in the nine months of 2002 was 13.11 m/month on average.
Advance of longwall face since the occurence of spontaneous fire on October 8 2002 until December 31 2002 was 12 meters in total.

3. ENDOGENOUS FIRES OCCURING AT THE ADVANCING SYSTEM OF TOTAL COAL THICKNESS MINING

3.1. Analysis of endogenous fire and remediation procedures - october 2002

First signs of endogenous fire occured on October 8, 2002, when the CO_2 concentration of 40 ppm was measured at the exit from the longwall face. Regardless of the effort to prevent oxidation process, it still progressed, resulting in CO_2 concentration of 135 ppm at the exit from the longwall face on October 13, 2002. The longwall face was ventilated with 4 m^3/s of air, absolute inflow of CO at the exit from the face increased to over 50 dm^3/min. The decision on closure of longwall face was made that day in order to prevent the endogenous fire. Incomplete closure with barrages in transport and ventilation corridor was finished on October 15, 2002. Barrages were constructed of concrete blocks with 0.8 x 0.6 m opennings on barrages that had to be closed simultaneously. Opennings served for air intake od aprox 1.3 m^3/s.The regular recording of the gas -ventilation parameters was conducted upon the closure, to carry out analyses regarding fire status and to undertake required remediation measures .
Control of gob sealing objects OP G-VII and 4/1 showed that there was an air contact between the working zone 207/1A (route between connecting rises VU-208/5 and VU 208/6) and the gob area. Increased CH_4 and CO_2 concentrations were detected at the workings, along with 40 ppm CO concentration upon the temporary closure of the longwall face. Therefore the operations at the workings were ceased and separate fan was shut down, while in the connecting rise VU-208/5 a ventilation concrete blocks barrage was constructed at the distance of 5 m from transport corridor.

Another barrage was constructed for closure of connecting rise VU -208/6 , because it proved that the mud plug 208/6 was not properly filled with sealing material. These barrages were constructed on October 15, 2002. Figure 3 shows a linear ventilation scheme of the VII terrace of the Eastern part (Block TB-IV) in Raspotočje mine upon closure of connecting rises (208/5 and 208/6) and the longwall face.

During the construction of sealing objects, a detailed inspections of sealing objects of the active mine part were conducted, and the following conclusions were drawn:

- Mud plugs that sealed the gob area from the ventilation rise VU-114 (MČ 70 and MČ 69), ventilation corridor VH -205 (MČ from 205/1 to 205/7) and ventilation corridor - 207/1 (MČ from 208/1 to 208/4) were in proper condition and there was no air contact with the gob area.
- Fire gasses (characteristic smell and measured concentration of CO up to 60 ppm) occured in the upper part of the longwall face
- Temperature at the exit from longwall face was reduced by 2°C in relation to temperature measured before closure (from 28°C to 26°C)
- Temperature at the top of the longwall face was reduced by 2°C (from 30 °C to 28°C)
- Absolute inflow of carbon monoxide (CO) was reduced to 15 dm^3/min
- Gasses concentrations measured at the top of longwall face were: CH_4 = 1,50 %, CO_2 = 1,0 % and CO = 65 ppm.
- Temperatures measured in OP-GVII-i-IV/1 varied from 19-20°C at the entrance to 25-26 °C at the exit from longwall face.

Fast stabilisation of conditions at longwall face that followed upon the construction of sealing barriers enabled restart of mining activities at longwall face, with supplied air volume of 2.80 m^3/s, without further occurence of CO up to beginning of December 2002. Figure 4 shows diagram of depression changes at mud plugs that seal the gob area of the working panel OP G VII-i/1, and Figure 5 shows diagram of temperature changes in front of the mud plugs that seal the working field OP G VII-i/1 for the period: 07.10.–24.10. 2002.

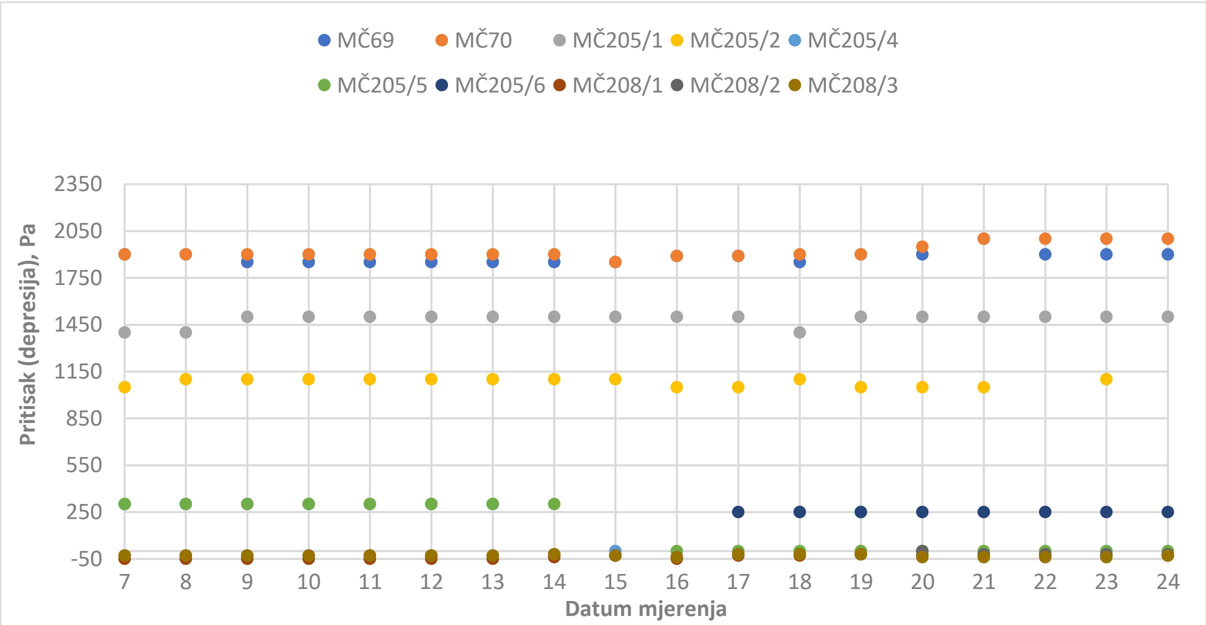

Figure 4. Diagram of depression changes at mud plugs that seal the gob area of the working panel OP G VII-i/1for the period: 07.10.–24.10. 2002.

Pressure values measured at the sealing barriers show the following:

- In ventilation corridor VH-205 (lateral line of the parallel), that served to take out return air, consumption of fan depression was extremely high: from MČ205/1 with pressure of approx. 1500 Pa to MČ 205/6, where it amounted up to 250 Pa (difference of 1250 Pa).
- In corridor 207/1 (diagonal), wall was under depression of -50 Pa at MČ 208/1 to – 20 Pa at MČ 208/3. Utilization of main fan depression at that route was insignificant since the working operations in that branch were ventilated using auxilliary (separate) fan.
- Measured pressure values at the walls of ventilation rise VU 114 (lateral line of the parallel were extremelly high: 1900 Pa at MČ 69 and 2000 Pa at MČ 70, as a consequence of installed flow regulator, under the location MČ 69 and 70, toward the intake air flow.
- Due to the big difference in pressure between the rooms from which the gob area was sealed, and due to big difference in pressures between these rooms and air current for ventilation of longwall face (open contact with the gob area), in the case of possible deterioration of sealing properties at mud plugs (MČ) or breakage of pillars between rooms and gob area, various combinations of air inflow into the gob area were feasible. Any kind of air inflow into the gob inevitably results in occurences of spontaneous oxidation and endogenous fire in the gob area (peripheral part of the gob area toward the fresh air flow) [4] .

Minor oscilations in pressure took place during the spontaneous burning process, dominantely as a result of gob area heating, and less because of changes in outside atmospheric pressure, that was quite stable in the observed period. These changes were mostly emphasized at the wall of room 207/1, where reduction and equalization of pressures at the walls along the entire route took place between 17th and 24th of October, 2002.

Changes in air flow in the branch for ventilation of longwall face, did not result in significant pressure changes at sealing objects, that can be a result of a complex ventilation system of working block TB-IV. Pressure decrease in branch for ventilation of longwall face (ŠČ) was not high, giving the short distance, adeqaute cross section of the route and relatively small quantity of air flow, therefore the changes in ventilation regime of longwall face did not significantly affect the potentials relations. However, these potentials changes, regardless how small they were, had a positive influence on creating favourable gas relations in gob area and creation of conditions, along with other measures applied, for proper supression of endogenous fire.

During the observed period the outside temperatures ranged from 4 to 15 degrees C. Temperatures at the entry ranged from 19 to 20 degrees, and 22-23 degrees at the exit from the longwall face.

Temperatures at sealing objects for the gob area from the ventilation corridor VH-205 (MČ 205/1, 205/2, 205/3, 205/4, 205/5 i 205/6), did not change significantly, and the total temperature increse was max 2 degrees in the observed period.

It can be explained by the position of sealing objects, that were 8-10 m lower than gob area (VH-ŠČ) and driven in the surrounding rocks (fault zone between TB-III and TB-IV). Similar alteration in temperature occured at the walls that close gob area of longwall face from the ventilation rise VU-114 (MČ 69 and 70). Those walls were the most distant from the assumed place of oxidation process, thus small temperature changes can be explained on those objects.

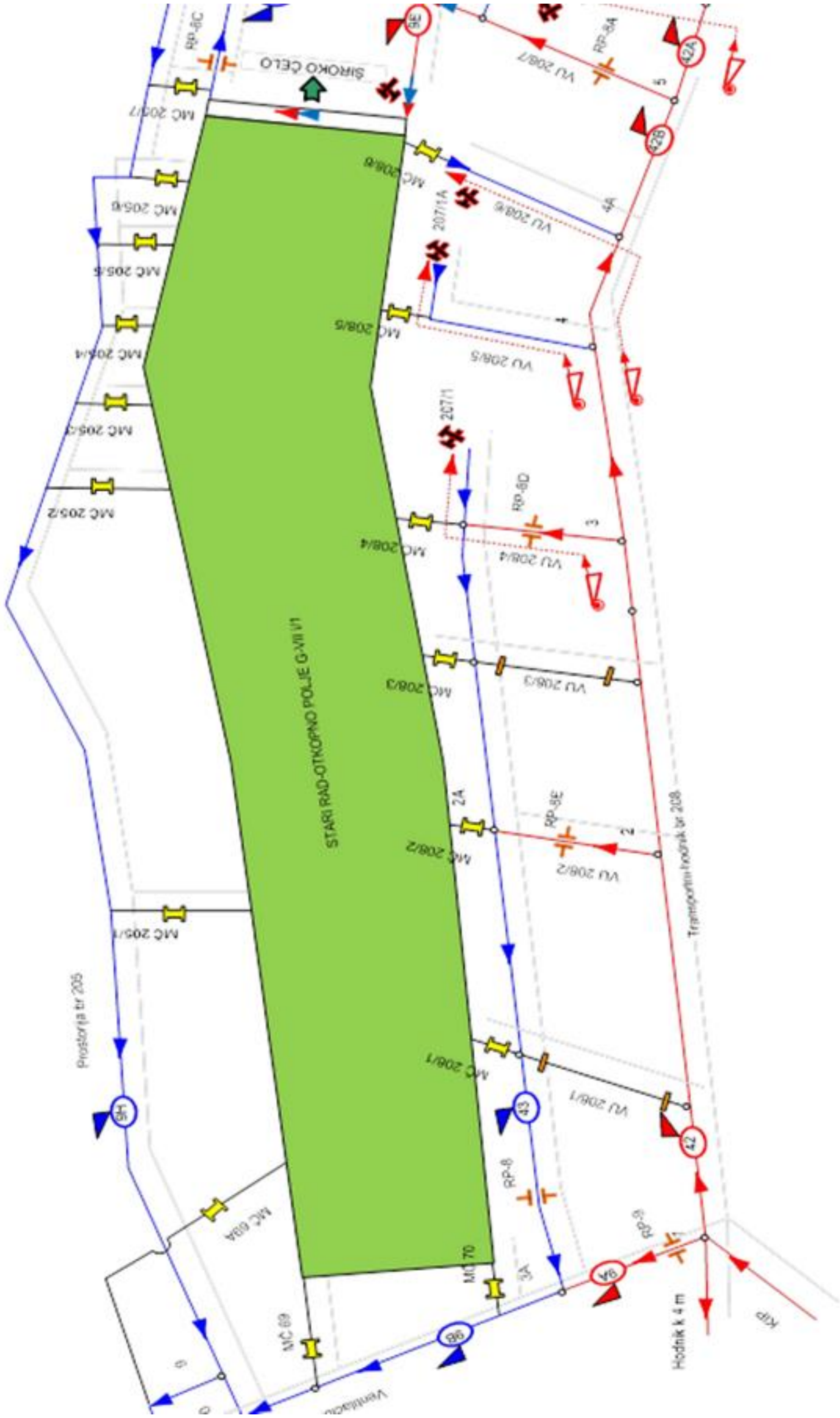

Figure 2. Linear ventilation scheme – VII Terrace , Eastern part (Block TB-IV) Raspotočje mine, before closure of the longwall face, Status: October 2002 [1]

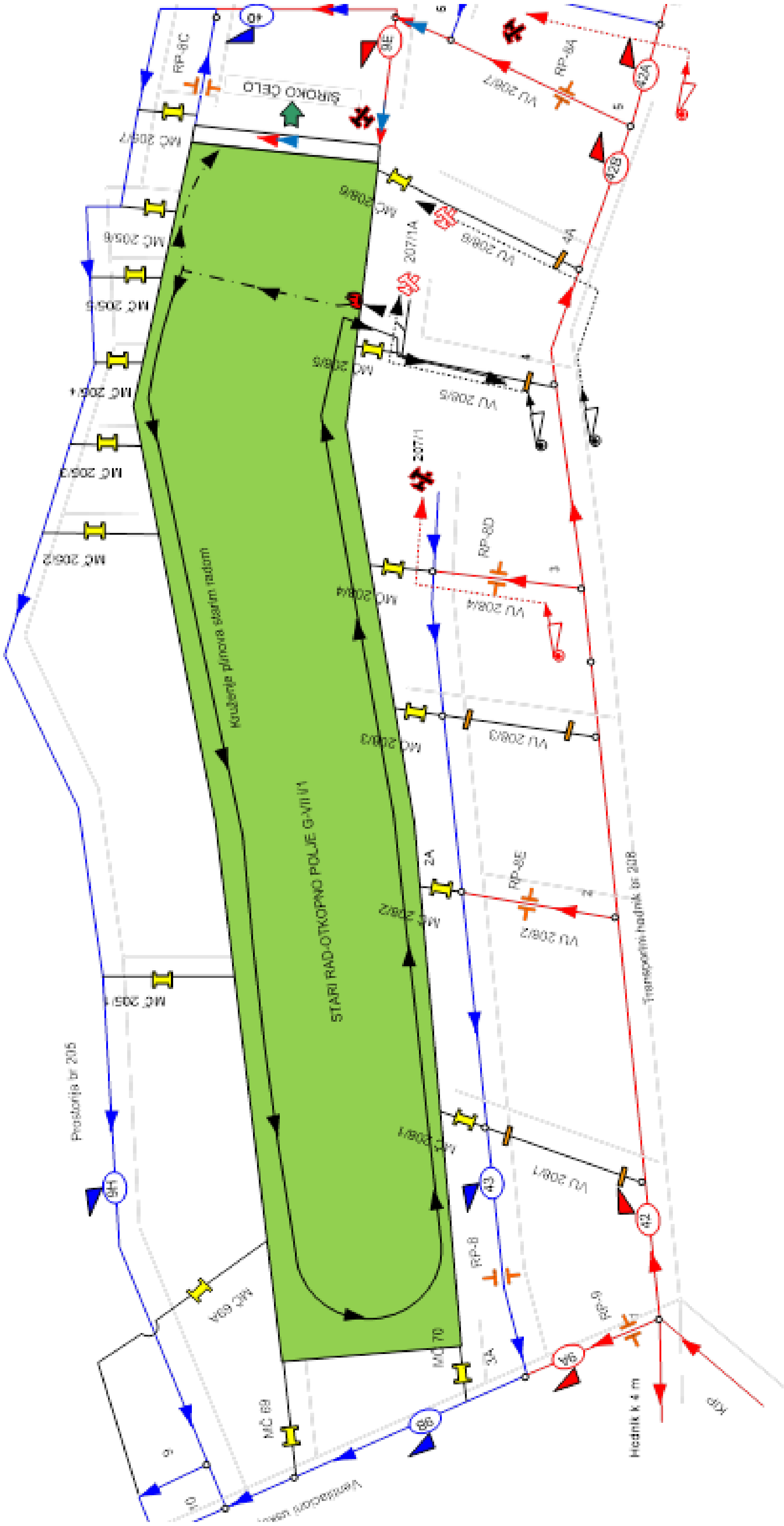

Figure 3. Linear ventilation scheme – VII Terrace , Eastern part (Block TB-IV) Raspotočje mine, upon closure of the longwall face and connecting rises (208/5 and 208/6) (Circulation of heated gasses in gob area OP G-VIII i/1, supression of methane from gob area and accumulation in ventilation rise VU 208/5) [1]

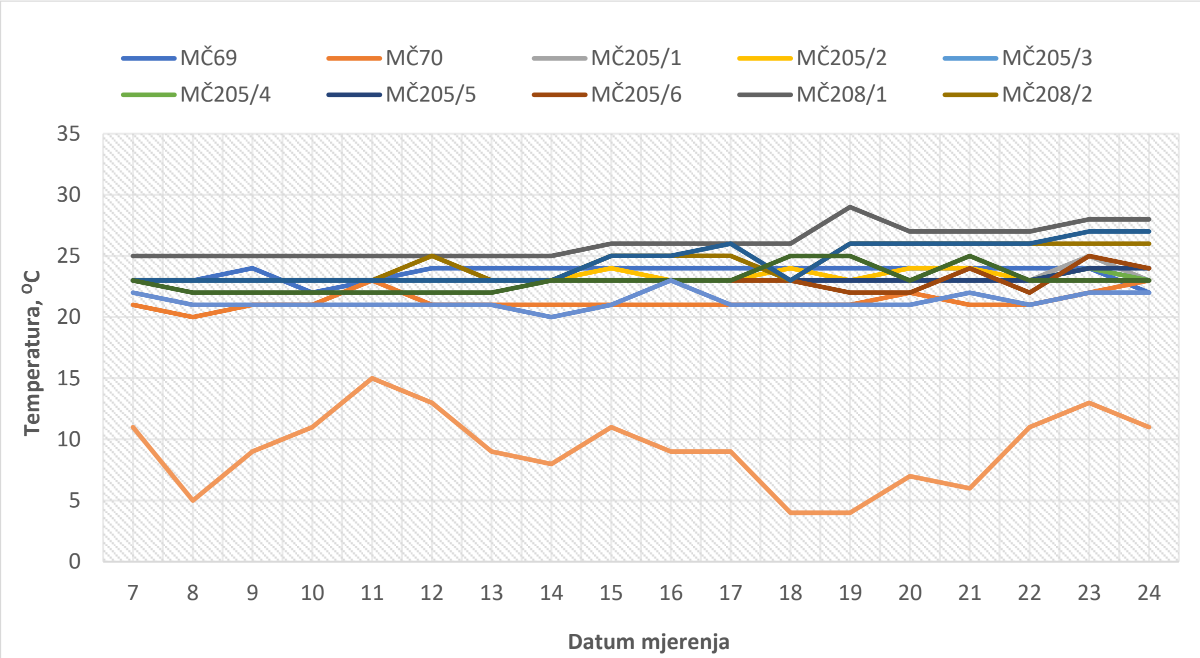

Figure 5. Diagram of temperature changes in front of mud plugs that seal working panel OP G VII-i/1 Period: 07.10.-24.10. 2002.

Temperature changes at mud plugs that seal the gob from the ventilation corridor VH-207/1 during the observed period were the highest. Total increase in temperature at MČ (except of MČ 208/4) were 4 °C. This can be explained by circulation of fire gasses through the gob area that was conditioned by temperature uplift and the shape of mined out gob area of ŠČ. Mining panel G VII-i-4/1 dips toward the longwall face advance direction, slightly diagonal on strike of Main coal seam (GUS) - strike of GUS is nortwest-southeast, with longwall face advance toward southeast. Dip angle of the mining panel is 11-15°, with average altitude difference between working corridors of 16 m.

The crucial role for creation of such gas movement in the gob area of longwall face, apart from the shape of mined out area, had some other influential factors such as: assumed position of spontaneous oxidation, intensity and development of endogenous fire, longwall face ventilation regime, with a negligible influence of main fan depression on longwall face (gob of the longwall workings). Temperatures at objects that seal the gob area from the transport corridor TH -208, did not change significantly, because of auxilliary barriers that were put to reinforce the previously installed mud plug (MČ).

Gas control of gob status behind the sealing objects was performed using chemical analysis method. It was detected that changes in gas conditions in front of the sealing objects were insignificant (normal). The determined gas conditions behind the sealing objects indicate following:

a) At the walls that seal the gob from ventilation rise VU-114 (walls no 69. and 70.) it was observed that gob was in the phase of consolidation. Oxygen content was under 12 %, carbon dioxide content over 6.5 %, and methane content aprox. 1.0 %. Presence of carbon monoxide was not detected by chemical analysis.

b) At the walls that seal the gob from ventilation corridor VH-205 the following changes were noticed:

- At the wall 205/1, that is the most distant from assumed spontaneous oxidation, no changes were detected.
  The gob area was consolidated, and no occurence of CO were registered.
- At the wall 205/3, an increased presence of oxygen was registered on October 9, 2002, along with 330 ppm of CO.

- The most significant changes of gas conditions at the beggining of spontaneous oxidation were registered on the wall no: 205/4, 205/5, 205/6, with content of CO ranging from 100 to 3500 PPM, and then significant changes occured only on the wall no 205/6.
- Significantly low content of methane on these walls (under 1.0 %) can be explained by movement of methane due to heat depression of accumulated fire gasses, that were moving toward the upper parts of gob area and it pushed the cooller methane into lower parts of gob area (circulation of fire gasses along gob area, supression of methane from the gob area into the room 208/5).
- As for the wall 205/6, content of CO on October 21, 2002, was increasing constantly, and then it started decreasing with simultaneous expected increase in CO_2 and decrease in O_2 content. Such behaviour of fire gasses behind the wall was expected as a direct consequence of measures undertaken on remediation of endogenous fire. Similar changes of gas status were registered at the top of longwall face (diffusely ventilated part of the longwall face).

c) Upon the intensification of endogenous fire walls that seal the gob from the transport corridor TH-208 were additionaly reinforced by concrete block barriers due to assumption that the air contact with gob of longwall face is enabled through these walls. The space behind the barrier 208/5 (connecting rise VU-208/5 and driven route of ventilation corridor VH-207/1A), of total volume of aprox 1000 m^3, was gassed soon upon the closure, with enormous methane content detected of over 50.0 %. Upon the closure of the rise, occurence of CO in traces of up to 5 ppm were registered by chemical analyses, while a concentration of CO of 40 ppm was registered before closure using portable measuring instrument. Behind the barrier no 208/6, that was installed simultaneously with barrier no 208/5, that seal ventilation rise VU-208/6, with total volume of aprox 600 m^3, the registered content of methane was up to 3.50 %.

   Such a drastic difference in methane content behind the two adjacent walls can be explained by the following hypotheses:

- Space behind the barrier is filled with gasses produced by exhalation from crushed coal seam due to crushing of the safety pillar, and trapped methane source that was opened by advance of the ventilation corridor VH-207/1,
- Behind those two walls was a space in which the endogenous fire occured, and methane was accumulated in ventilation rise 208/5 due to described circulation of fire gasses in the gob area and crushing of the safety pillar between the gob and driven part of the ventilation rise VU-207/1, situated in the roof plate of the Main coal seam. This occured partly because of the condition of the walls in ventilation system, that was mainly close to balanced values (depression on wall was 0 Pa).
- However, the hypothesis concerning the existance of connection between VH-207/1A and the gob area OP G-VII-i-4/1, and hypothesis on circulation of gasses in the gob area OP G-VII-i/1, supression of methane from the gob area and its accumulation in VU 208/5, were confirmed with this analysis. See Figure 3.

d) Analyses of recording taken behind the walls that seal the gob from the room 207/1 (walls no 208/1, 208/2 and 208/3) were mostly dependant on sampling model (experience of the sampler) [7] , since those walls were under a small depression (retracting) during the observed period.

   Recording of gasses conditions behind and gas-ventilation parameters in front of the walls deny possibility of any kind of air flow through the gob area toward and away from the objects that seal the gob area from the rooms VH-205 and VU-114, and walls that seal the gob from the room VH-207/1 (walls no.208/1, 208/2 and 208/3). Only potentially suspicious were the walls no 208/5 and 208/6.

e) The exact location of spontaneous oxidation was not reliably determined but analysis of influential factors lead to assumption that the oxidation process occured in the safety pillar, at the edge of gob area toward VH-207/1A, between walls no 208/5 and 208/6, see Figure 3.

3.2 Analysis of reactivated endogenous fire - December, 2002.

Reactivation of endogenous fire occured in the beginning of December due to a wrong decision brought regarding continuation of activities on drivage of remaining part of ventilation corridor VH-207/1, i.e. opening and degassing of VU-208/5 and VU-208/6 [1]. Upon degassing of connecting rise, drivage of a part of the ventilation corridor VH-207/1A between the rise 208/5 and 208/6 and assembly rise (MU) and TH-208 was started.

Openning of connecting rises resulted in intense endogenous fire with CO concentration reaching 1000 ppm in five days. Therefore the further longwall face operations were ceased on December 5, 2002,

and then it was closed again. Active measures were carried out to prevent quick intensification of endogenous fire (Slurying, splashing and soaking of the gob area) but its supression was not feasible.
Analysis of operational data (recording of gas status and temperature along the longwall face , and „in situ“ data on occurences of condensation on self powered hydraulic support (SHP) proved that fire was getting closer to the lower part of the longwall face. Therefore a fanlike disposition of drillholes was applied and they were drilled from the assembly rise (MU), with the aim of drillholes reaching the highest point of caving arch of the immediate roof , while in the line of coal seam they created a hypotenuse of a triangle: longwall face line TH 207- drillhole line penetration into the assumed spontaneous oxidation zone. The intention was to supress the endogenous fire in total through slurying from drillholes and splashing from the longwall face area in that triangle, and that was fully achieved.

A filtration barrier was constructed for that purpose in transport corridor TH-207, behind which a mud plug was created in the floor of the room, in length of 40.0 m, that slurried and supressed the fire in fine coal along the transport corridor, and prevented air flow into the oxidation process. Simultaneously the gob area was splashed with solution of electro filter ash from the active part of longwall face, especially in its lower part.

Active remediation measures were followed by ventilation measures. Driving of the assembly rise (route 4-7A) resulted in significant decrease of resistance in TB-IV, especially in the zone of active workings (chamber workings and longwall face). Route 7A-7-8, was used as an extinguishing branch. The room was generally cleared of piled up coal, while equipment and auxiliary materials were removed in order to decrease resistance along the route (decrease in difference of potentials along the route). Thus the potentials at the entrance and the exit from the longwall face were equalized (usage of depression at the route 7A-7-8 was reduced to minimum). A regulator (RP-8B) was installed in the assembly rise to regulate air flow to 5.0 m^3/s. Simultaneously a combined ventilation system was applied at the longwall face, using separate fan. Total air flow for ventilation of longwall face was 3.0 m^3/s, consisting of air flow driven by separate fan of 3 m^3/s, while aprox 0,7 m^3/s were driven by main fan. Separate fan was installed in the transport corridor TH-207, at the entrance into the longwall face, with the end of the pipeline for separate ventilation on the 23rd unit of the self-powered hydralic support SHP (43 m of the longwall face).
Regulation of the required air flow was carried out by damping at the end of the pipeline, while regulation of the total air quantities for longwall face was made using air flow regulator 8C.

In that way the influence of the main fan on the gob of the longwall face was reduced. That resulted in reduction of migration of air through the gob area of the longwall face, reduction of fire gasses circulation into the working space of longwall face, and the line of consolidated gob get closer to longwall face line, and along with all other measures undertaken, it resulted in complete supression of oxidation proces, by the midst of January 2003. Canonic ventilation scheme of the Eastern part of Raspotočje mine (TB-IV) upon reclosure of connecting rises VU-208/5 and VU 208/6 and assembly rise (MU) is shown in Figure 6. Figure 7 shows a diagram of fire coefficient based on occurence of CO, on the exit from longwall face , for the period October 8 to December 31, 2002. During that period occurence of endogenous fire took place, then closure of the longwall face, followed by its opening, reoxidation process and reclosure of longwall face. Comparative diagram of fire coefficients: G, QCO, CO/CO_2 shows all mentioned changes. Indicators have predictible values, timely indicate all mentioned changes that longwall face passed through, and they overlap each other very well. During the process of reoxidation of fire all indicators had significantly high values, due to intensity and force of fire upon reactivation. Upon the sealing of the area a decrease and stabilization of parameters took place.

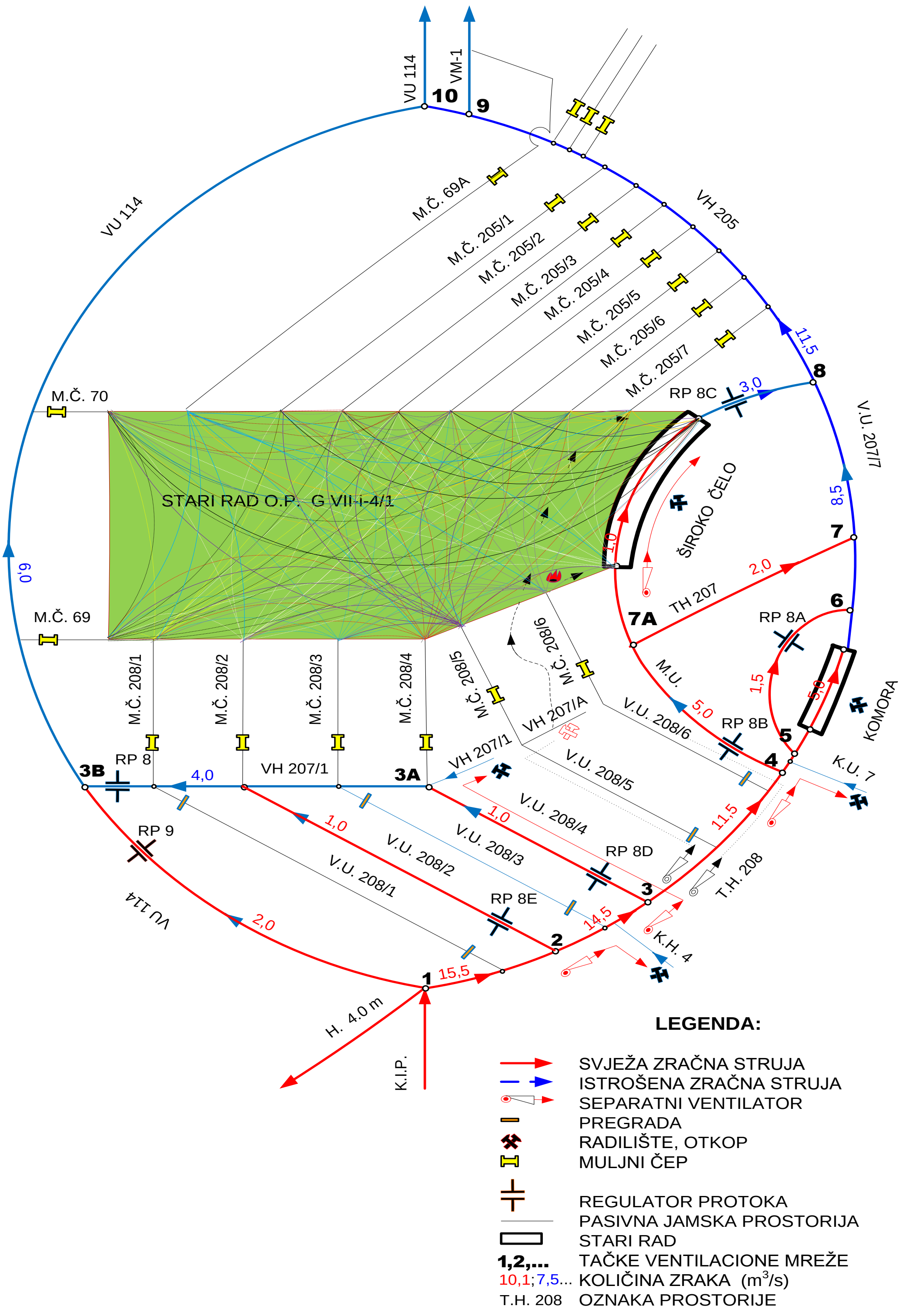

Figure 6. Canonic ventilation scheme of the Eastern part of Raspotočje mine (TB-IV) upon reclosure of the connecting rises VU-208/5 and VU 208/6 and construction of assembly rise (MU); Status on December, 2002 [1] (Graphical analysis of possible air flow lines (migration) through the gob area of longwall face)

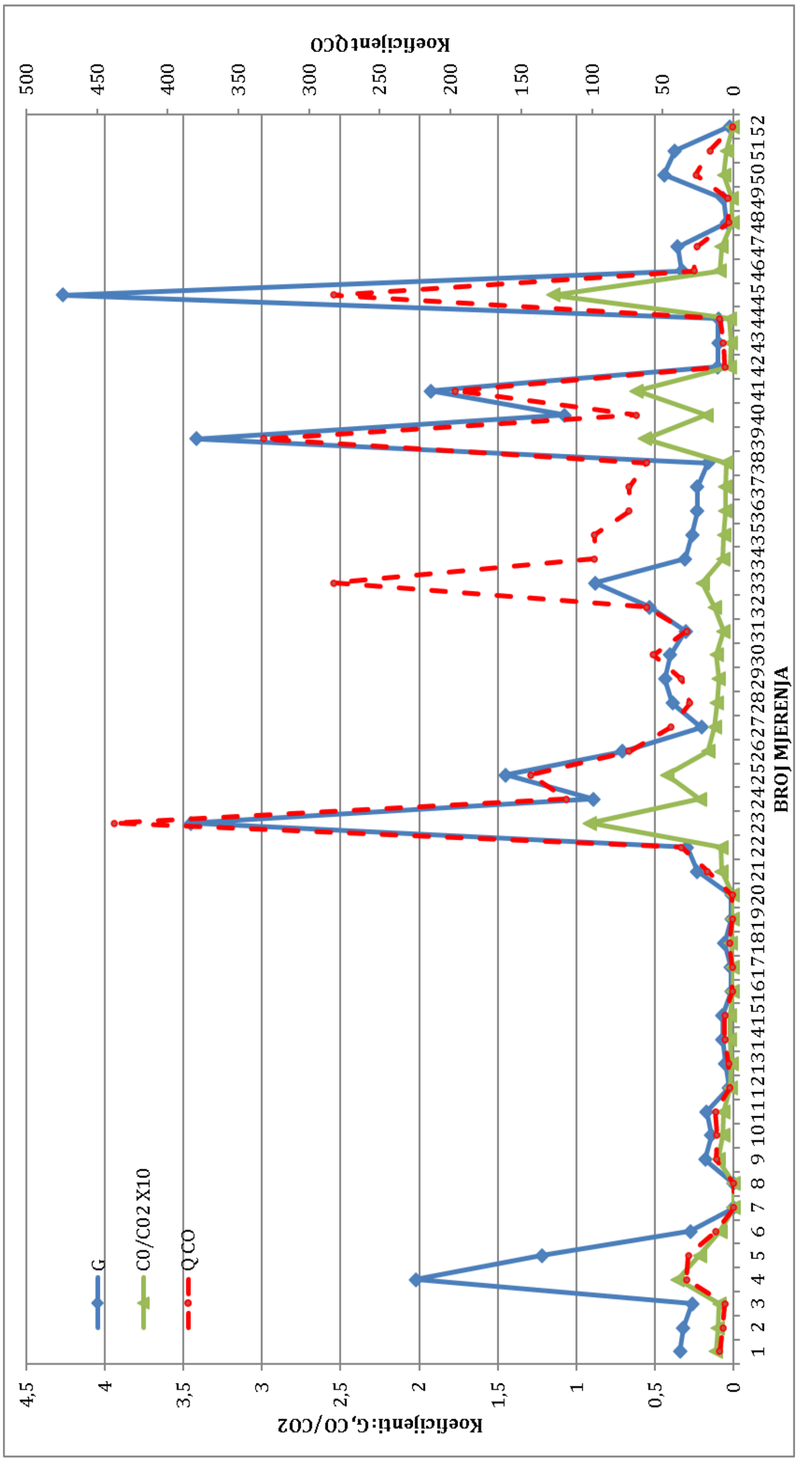

Figure 7. Comparative diagram of fire coefficients : G, Q CO, CO/CO_2, at the exit from longwall face (ŠČ)

CONCLUSIONS

Longwall face method applied in undeground operations of Zenica coal mine include roof caving into the mined out voids, without stowing of mined out areas. Consequences of such mining methods include significant air flow (migration) through mined out space (gob) of the longwall workings. Such air migrations often resulted in occurences of spontaneous oxidation and development of endogenous fire in gob area of the longwall face, especially in situations that include poor management of fire prophylactic measures (unnecessary directing of increase air quantities through longwall face, bad management of ventilation screens for prevention of air flow in lower and upper chamber of longwall face, untimely closure of rooms upon completion of operation at longwall face, collapsing of safety pillars between mining panels due to insufficient width of pillars, and other) [1].

Prime disadvantage of advancing mining method is increased usage of consumption of depression due to length of ventilation ways (increased length of panel openning corridors), and creation of a large number of potential lines of air flow (air migration lines) through the gob of longwall face, between the sealing objects, as well as between sealing objects and longwall face line. One of the solutions to the problem is development of working panels with less connections in the panel itself, especially connections driven through safety pillars toward the adjacent panels. That would decrease number of sealing objects and possible air migration lines through the gob of the longwall panel.

Complexity of endogenous fires occurences in underground operations of Zenica coal mine require implementation of efficient measures and procedures for their supression.
The efficiency of the measures and technologies for open fire controlling are mostly dependent on the location, status, and duration of the fire. Intensity and duration are also dominating factors for the better efficiency of the measures. Effective techniques require a better understanding of the strengths and limitations of each measure and the behaviour of the fire, and a realistic work programme based on the extent and rate of progress of the fire [6].

Analysis of fire in mine operations of Zenica Brown coal mines that occured during the mining of the main coal seam (GUS) using longwall method showed that application of a single protection method or procedure is not sufficient for supressing endgoneous fires [1] [2]. The success can be expected only by applying a combination of various protection measures and procedures, otherwhise applied measures would not yield required results.

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