

COAL AND GAS OUTBURST COMMITTEE

HALF DAY SEMINAR – Wollongong 28th June, 2017

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Editor's Comments: Another excellent seminar with a lot of knowledge shared. I have attempted to accurately record the discussions. I tried to quote verbatim where I could, but in places the audio quality was poor and I needed to guess. Some people asking questions spoke quietly (especially their names), held the microphone, away from their mouths, or did not use a microphone. As I am challenged with a degree of industrial deafness, I may have misquoted them.

John Hanes

Deep Penetrating Ground Radar

Phil McClelland, Ultramag Geophysics

Questions and Discussion

Dave Gordon, Resource Regulator NSW: How does the GPR compare with RIM?

Phil: GPR is very crude in comparison with RIM. It just measures radio intensity strength, so there is no two way travel time information and no indication of distance, just what is happening between two points: a yes/no answer. It is a different concept. I think GPR is more powerful as it will cover a bigger distance than RIM. I was given a commercial opportunity to purchase RIM and I declined.

Bruce Calderwood, Austar Yancoal: What sort of depth would you be confident for looking at structures?

Phil: It depends on the overburden type. If it is mainly shale, 100 m is feasible. Say 200 m for sandstone. With a combination of these, it depends on the number of layers and the dielectrics. It is best to do a quick trial that can be calibrated against known geology and you soon get an idea if it will work. We are working on a higher powered version for better penetration. We have some experimental antennae that go out to 10 m wavelength so we can get more distance with a long wavelength. But once you go for a longer wavelength, you lose resolution. At present, the 6 m antennae are optimised as we can pick structures of the order of 3 to 10 m thick at 150 m depth. As you extend the antennae to 10 m, the resolution is of the order of around 10 m at the same depth. It depends on what you are looking for. We are also looking at flicking energy sideways, similar to a side scan sonar. That should give us a 3D picture similar to 3D seismic. But it can be done for a fraction of the cost of seismic. The antennae are dragged along and the results are displayed near-instantaneously. We can also shoot from one transmitter to multiple sensors.

Chris Harvey, Outburst Seminar Committee: In an underground coal application, what size geological disturbance can you locate?

Phil: It is governed by the antenna frequency. If shooting with 3 m antennae, we could probably pick up a 1 m offset at about 50 m. It depends what medium you are shooting through. If shooting through clays, the return signals are weaker. I haven't yet done any experiments shooting through blocks of coal, but I suspect it will be similar to shooting through shale. If shooting for a close structure at say 10 m, we could use high frequency antennae and achieve 0.1 m resolution.

Dennis Black, Pacific MGM: What is the diameter of your probes and could they be inserted into a hole?

Phil: We could probably squeeze the 3 m antenna into a 120 mm hole, but any (metal) casing becomes part of the antenna system. Even the hole itself is conductive and becomes part of the antenna. We would love to try it if someone is prepared to sponsor a trial. There are some low powered radar probes available which might be able to be redesigned including the electronics. Getting the transmitters into a borehole should not be a big problem, but getting the antennae into a borehole poses a problem. Water in the coal also contributes problems, so it is not a trivial challenge.

Stimulation of Gas Flows Using Nitrogen Injection

Ting Ren, University of Wollongong

Questions and Discussion

Winton Gale, SCT: At the start of the production hole, before you injected nitrogen, it looked to me that you had 50 to 60% N₂+CO₂ in the gas composition.

Ting: two boreholes were drilled and shut-in to monitor pressure build up and gas composition changes. No gas flow was observed for the production hole however strong gas flow was observed from the injection hole. Gas composition from production was initially 35-60% CO₂ and the rest being nitrogen (N₂) as a result of pre-injection of nitrogen to test borehole blockage. Gas composition from the injection was almost 100% CO₂ before the start of nitrogen injection.

Martin Owen, Owen Consulting: Why did you choose nitrogen for the injection gas? Did you consider other gases such as Helium or Argon or others?

Ting: We gave a lot of consideration before the project and in conjunction with Metropolitan Colliery staff who expressed some concerns about injecting compressed air and gas into their boreholes. The reason we chose nitrogen was mainly its availability and that it had been previously used in China, Australia, Canada and other countries. I am sure other gases could be tried, but it will come down to availability and cost. We could start by trialling other gases such as helium in the laboratory to see if they might be a better option.

Dennis Black, Pacific MGM: In using nitrogen as opposed to something like helium, nitrogen has better absorption characteristics and can better displace CO₂ out of the coal matrix. Did you get any post-test gas content tests done to check the actual effects on Q₂ and Q₃?

Ting: We hoped to get 6 samples from the trial site to test gas contents, but as Metrop. is focussed on production, this has not yet occurred. I have had a phone call today from Alistair that in two weeks he hopes to get us cores from the trial site. So we should then have the data to assess the impact of the injection trial.

Dennis: If you haven't already done so, it would be interesting to compare the initial point of gas content on the isotherm curve to see at the bubble point, is that equivalent to the initial kick-off pressure?

Ting: This would be an interesting study. The kick-off pressure would be the one overcoming the borehole resistance and seam permeability as well as the in-situ gas pressure. We are trying to establish the CO₂:N₂ ratio that is needed to flush out the gas content and how long it takes to drop below the threshold, and also the volume of nitrogen required to do

this. We are hoping that data from the field trial and laboratory studies can be used in our reservoir simulation model, we can then then determine and optimise the operational parameters.

Dennis: The only potential problem is lab sample data versus in-situ data in bringing pressure down.

Ting: you are correct. In the lab, we are introducing so-called back pressure, mimicking the resistance and reservoir pressure.

Metropolitan, Longwall 27 Outburst Events

Andy Hyslop, General Manager, Metropolitan Colliery

Questions and Discussion

Bob Myatt, Mine Safety: When you said the initial hole was not making any gas, what was your thinking at that time? You would have got together with your team and asked what is happening here?

Andy: We asked ourselves those questions many times. At Metrop we have drilled thousands of holes and it is unusual to find a hole that doesn't make gas. Outbye of the structured area, we had holes that had been drilled in 2010 that had no flow. I would have expected gas to have flowed from the holes that were drilled through the fault.

Bob Myatt: What I am getting at is you and your team would have discussed that hole and asked what was happening.

Andy: We did. We decided there was nothing unusual happening. There was no indication from that hole that would indicate we had high gas in that area, the mine has never had boreholes drilled and not make gas only in areas that have been previously drained.

Gary Parker, Dept Planning Mine safety: I have noticed that you have done some good work with your outburst management plan focussing on the longwall and longwall extraction process. You mentioned you now have procedures to assess outburst structures. Do you have a definition of what your outburst prone structures are? For example, the obvious ones are the strike slip faults and mylonite zones. But what about those areas where you drill, it is boggy and you cannot get a hole through and you know the drainage will be sub-standard?

Andy: A good question. It is one we debate regularly on site. Shane Kornak the mine geologist is very accurate with his mapping and has a lot of structures on his geological model. What we determine is an outburst prone structure is one which will have ineffective drainage and pose an outburst risk. We will know that from our drilling performance. If we cannot drill it, it is an outburst prone structure. If drilling becomes boggy, we err on the side of caution and treat the structure as outburst prone.

Mark Fisher, Resource Regulator: I would like to verify something Andy commented on. It cannot be seen on the photos Andy showed, but the difference between the site where the event occurred and men could have been lost, and the maingate 60 to 70 m away, the same structure, where it occurred in the maingate was similar to a line drawn with a pencil. These structures must be dealt with cautiously as they can change in a short distance. My question is

can you recall the nature of the structure in maingate 26? I cannot remember mylonite showing there.

Shane Kornek, Geologist, Metropolitan: In maingate 26, there was some mylonite, about 1 mm wide, along with multiple shear planes over 1.5 m.

Andy: In our Outburst Review Committee, we looked at drilling and development of 7 gateroads and 6 longwalls that had crossed the structure. Maingate 27 developed through the structure on normal mining with no problems. What we found with this event, we would never have thought we had a localised pocket of gas as we found.

Graham Healy, Centennial: (poor quality audio) You must have had some nervous moments with men working on the tailgate side of the fault.

Andy: There is nothing out there that stipulates a wait time. Each event occurred no longer than 4 minutes after the shearer cut it. (JH: so they were not instantaneous on cutting?) So we have decided on a 20 minute wait time based on our experience in the mine. We have a lot of experience with grunching where a 10 minute wait time has been adopted since around 20 years ago.

Mark Blanch: Since Ripu recommended reducing rate of mining on the approach to an outburst prone structure if the gas content could not be reduced below the threshold, the logic has been to allow time for the gas to bleed. The events at Metrop seem to be a case where you cannot creep up on an outburst as there was a fairly long time between each of the three events.

Winton Gale: How close to the burst were the longitudinal holes you showed?

Andy: Right through the outburst area. We are still scratching our heads over that.

Dave Gordon: Was there any seismic activity associated with the bursts?

Andy: At Appin, a few minutes before the third and major event, there was an earthquake event around 4 on the Richter scale. But it was a coincidence.

John Hanes, ex BHP Mine Geologist: Andy, congratulations for your frank presentation. It is such willingness to share knowledge that allows others to learn and hopefully, to help save lives. I would just like to make a comment from my experience. In about 1974 -75 when crude gas drainage attempts were started at Leichhardt Colliery in Central Queensland, where the gas content was around 12 to 15 m³/tonne CH₄ at a pressure of over 2 MPa within 2 m of the face. The holes were initially drilled with an auger drill and were 12 inches diameter.

They were around 30 m long. In my ignorance, I questioned Alan Hargraves how could the holes be draining gas as I could not feel or hear gas coming from the holes and the deputy could not detect gas on his flame safety lamp. My memory of this was triggered by your description of what seemed to me as a similar occurrence with the drainage hole at Metrop. At Leichhardt, in the couple of years following the 1978 fatal outburst, we were able to show that the permeability was very low and that gas would not start to flow into drainage holes until around 60 days after the holes were drilled. No gas emitting from the holes initially did not indicate no gas in the coal: It indicated no permeability. This was a very much different situation from what was understood at the time to be the norm for the Bulli seam where holes flowed immediately on drilling.

Update on ACARP coal burst project C25004

Ismet Canbulat, University NSW

Questions and Discussion

Bob Kininmonth, Outburst Seminar Committee: Do you have a record of how many coal bursts have occurred in Australian mines?

Ismet: Officially or unofficially? Officially there have been 3. Coal bursts have been discussed for a long time from Australian mines, but their magnitudes have been small. Listening to old miners, there are descriptions of events which might have been coal bursts or might have been outbursts or something else. So we adopted a quantitative way of looking at them, based on magnitude. In China and USA, there are thousands of small events.

Winton Gale, SCT: In Australia there is no recorded seismic activity associated with coal bursts, but when we look at the ranking or weighting of seismic activity in your tables, it is important.

Ismet: We are talking about large events. When we look at the data, all Australian events are very small. At Appin there was a seismic event of scale around 3.

Winton: Did that recent event at Appin go onto the rank scale?

Ismet: It was an earthquake, not a coal burst.

Anon, North Goonyella: (very poor audio – did not use microphone) 10 to 15 years ago, some people believed they could recognise stress in coal using seismic tomography or similar; is there any developments on that?

Ismet: A good question. CSIRO have been working on that for quite a few years now. In China, all longwalls are monitored by seismic networks 24/7. They can measure stress regimes and stress change from seismic. They also drill ahead of longwalls to do stress measurements.

Andrew Newlands, Tarant Geomechanics: Geoscience Australia seismic grid is quite coarse and not necessarily suited for detecting coal bursts. Also, the geology of Australian coal deposits is quite different from the Carboniferous deposits of USA.

Ismet: That is right. They put a high weighting on competent strata in USA. Australian conditions are very different. What we have shown as a method is not prescriptive. It is just to give some relative ranking information.

Anon, University of Wollongong: (poor audio) How were the weightings derived? What was the rationale behind the make-up of the personnel in the project?

Ismet: The weightings were based on our database from Australia, USA and China. Non coal burst event mines are also important, as in Australia where there is a lot of data. The aim of the study was to separate coal burst cases from the none-coal burst cases.

Anon: Why weren't Polish experiences considered and included?

Ismet: It was simply a matter of having access to data. We just could not get the necessary data for the data base from Poland.

Regarding the personnel in the project, most UNSW researchers' time is free in the project. But more importantly, the project was something new and everyone had their own ideas. It was suggested we get everyone together in one room and share their ideas.

Regulator perspective on Outburst Management

Dave McLean, Chief Inspector of Mines

Questions and Discussion

No questions.