Recognising Geological Structures

An element of the Appin Colliery Outburst Management Plan is that all in-seam drill operators be trained to recognise geological anomalies.

Through observation and subsequent recording of structures whilst drilling, historical information and submissions from geologists, management can identify potentially hazardous areas and respond accordingly. Below are some of the signs which may indicate a geological structure, whilst drilling using rotary or down-hole motor drilling.

Jointing
- Direction will be hard to maintain as the drill normally wants to align itself with the joint planes (easy to track with the survey tool).
- Size and shape of cuttings may change, they may become large and irregular. The cuttings could have a greasy, shiny surface along one plane.

An operator may experience "bogging" due to a blockage of water behind the bit, caused by odd shaped cuttings.

Mylonite
- Gas flow will be intense and of long duration.
- Tailings will appear frothy with a reddish tinge.
- Use an operator or you may find it possible to push the rods through the material without rotation.
- Fine dust, similar to talcum powder, will appear on the rods or in the tailings.
- The water will be very black.
- Mylonite will attach itself to the rods when they are being pulled. It is a fine, black, caked material with perhaps a faint red tinge.
Fault

- Rods may bog down due to a change in both stress magnitude and stress direction.
- The tailings may show a "wrong" colour relative to the normal sequence of colours.
- The position of the motor may not correlate with the colour of the tailings. Check this fact by pulling back to a known reference point. Check seam detail as inferred by surface borehole information.
- The drill string cannot be held or it may in the seam keep getting pushed into the roof or the floor. This is typical of a slip-strike fault.

Hard Dyke

- Beware of cindered coal, either side of the dyke.
- These are igneous intrusions and the tailings will be very fine but gritty, due to the grinding nature of the bit on very hard rock.
- The tailings would show a dramatic change of colour from black to off white, to pearly white.
- Just before the colour change (dependent on the length of the hole) there will be a dramatic change in terms of decreased feed rate.
- A "DHM" may stall due to the hardness of the dyke.

Soft Dyke

- Dramatic change of colour from black to pearly white.
- Change of motor pitch due to the softer nature of the dyke.
- Feed rate should increase, (length of time of increased feed rate is directly proportional to the width of the dyke).
- Feed rate may have to be adjusted to suit the amount of flushing water available, otherwise bogging may occur.
- Cuttings in the tailings are virtually non-existent because of the soft nature of the material and the effect of water on it.

High stress zone

- Rods will bog down in coal.
- Down hole motor will stall in coal.
- Cuttings will be the size of ten cent pieces and will accumulate behind the bit, causing bogging due to restricted water flow.

It is important not to mistake a hole that needs flushing for a high stress zone.
Hazards Associated with Geological Anomalies

Whilst drilling are:

- Ejection of rods due to gas pressure.
- Ejection of solid material due to gas pressure.
- Water pressure stored in blocked drill string.
- Torque built up in jammed drill string.
- Gas($CO_2$, $CH_4$), issuing from hole, lines separator or drill string and accumulating at the drill site.

- Stored pressure in the hole and associated suction line due to solid material and/or water blocking the line.

To contend with such hazards:

- do not position yourself in line with the drill string.
- Wear eye protection at all times.
- Ensure water pressure is dissipated by opening bypass valve.
- Ensure rod holder or chuck is opened at some stage to release potential torque before working on drill string.
- Position methane detector correctly, maintain good ventilation, and maintain good suction by removing water or blockages from suction lines.
- Use a non-return valve in the drill string, to prevent gas issuing from the drill string.
- Use a stuffing box to apply suction to the hole.
- Before disconnecting suction hoses or equipment ensure that there is no stored pressure by opening the valve in the "T" piece of the stand pipe.
Core Sampling

Taking samples of coal is a traditional method of obtaining information about coal qualities before mining proceeds in a given area. Originally, samples taken at intervals of approx. one kilometre, with the holes and subsequent sampling undertaken from the surface. Currently, due to an increased demand for a safer working environment sampling, under certain circumstances is undertaken at 10m intervals by in-seam drilling, but normally 100m intervals. In this case, coring is required as part of the Outburst Management Plan. (refer next page) (Figure 40).

Information gathered in this way gives the management team an accurate indication of the amount of gas and its content in an area. With this information, decisions can be made on whether secondary drilling and drainage is required and how mining can be undertaken without the risk of outbursts.
Refer to the "Outburst Risk Review Update" in Brennan 28 Panel on the 2nd June 1996. Core GAP 387 shows the following:

CO₂ - 16%

Gas content - 5.2 m³/m³

Using the Threshold Limit Value Graph (See next page) it can be seen that the content and composition indicate that mining can occur under normal conditions.

**AUTHORITY TO MINE**

**BRENNAN 28**

A strata hole was drilled from B platform and core samples were taken for analysis of gas content and composition.

*5.0% CO₂ 9 samples 1.2% CO₂ 3.0% CO₂ 1.4% CO₂

As the results of the gas content and compositions are within the limits set under the Outburst Management Plan, mining can proceed under normal conditions.

**SECTION**

Any strata testing as stated above may be requested in the future.

A strata hole will be commenced approximately 75 metres below the CS of 1.1 level in B platform. This will be located on the eastern edge of the mine after working out holes.

(Figure 41)
Underground Core Sampling Steps

Receive "coreing" instructions in written format on the form Q5-AGM-SF005 from the drilling supervisor.

Pre-operation Checks

1. Check that the drill rig is set up at the correct location & with the azimuth prescribed by the engineer's details.

2. **Critical**: Determine the depth of the hole and the number of rods required for the specific depth to commence "coreing".

3. Check core barrel is serviceable:
   - Core breaker free and pushed back.
   - Core barrel bit is sharp and not damaged.
   - Check components are seated and screwed together.
   - Check for good water flow.

4. To set up desorber:
   - Check that equipment is serviceable.
   - Fill cylinder with water, cover with beaker and invert, fill beaker with water.
   - Adjust water level in beaker so it is level with tube in the cylinder.
(Figure 43). Disgorger Set-up.

- Clamp (the above) to the stand & adjust so water inside the cylinder is level.
- Blow through the tube to ensure there is little resistance and position water level in cylinder at an increment mark.
- Record this increment as the zero level on the form QS-TSGM-SF001.

Commence Drilling
1. Drill hole adhering to prescribed details.
   - Record drilling characteristics relevant to each rod.

2. Stop drilling.
   - Check that the drill string has stopped at the correct position relative to face or centreline.
   - Record time on the record sheet (QS-TSGM-SF001) using 24hr time. i.e. hrs, min, sec. (Figure 44 page 142).

3. With draw drill string.
   - Check that the end of the drill string is blanked off to prevent dirt entering.
   - Check that the observer is used where necessary to ensure drill string is safely withdrawn.

4. Couple core barrel to drill string.
   - Push rods back to the face of the hole.
   - Couple water supply to rods and allow water to flush to drill face.
5. Start Coring.
   • *Critical*: Note time on appropriate form when rotation was applied and coring was commenced i.e. the time core barrel begins cutting coal.

   • *Critical*: Check progress of core barrel in the coal and note the time when the core barrel stopped cutting coal.

7. Withdraw Drill String.

8. Uncouple Core Barrel.
   • Disassemble core barrel.
   • Transfer coal sample to 'bomb'.
   • Ensure rubber seals are clean before placing on cap
   • Seal bomb to ensure there are no leaks and valve should remain open.

9. Connect Sample to Disorber.
   Using the form QS-TSGM-SF001
   • Note time sample is connected to disorber alongside level in the graduate cylinder.
   • Observe the rate the gas is disorbed from the sample by accurately noting the change in volume and the times of the changes.
   • Record time at every 20ml level or change in volume.
   • Record a minimum of 6 readings if gassy and periodical readings thereafter.
   • Continue disorption for as long as possible, at least 20 mins. Record final reading as "bomb closed" and include time, disconnect tube from bomb.
   • If no disorption after 15 minutes, turn off and check for leaks.
   • Seal cylinders at the end of the observation period by turning off the valve on the bombs and secure to transport.

10. Complete QS-AGM-SF005
    (E.O.S.Coring Details)

11. Complete QS-TSGM-SF001
    • Illustrate coring location.
    • Detail coring location, relative to a cut-through centre line.
    • Date and sign.

12. Return Core Sample and Data to Supervisor or Control.
### UNDERGROUND GAS CONTENT SAMPLE COLLECTION REPORT

**Section 3.0**

**CORE SAMPLING**

#### BHP Gasoline Corp.

**UNDERGROUND GAS CONTENT SAMPLE COLLECTION REPORT**

**IN SIKAM AND CROSS-MEASURE DRILLING**

**COLLECTOR:**

**T5 HOLE No:**

**COREDRY ROLL No:**

**DATE:** 1/5/96

**LOCATION PLAN**

**HOLE SURVEY DISCS ATTACHED**

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**CORE SAMPLE**

- C: Coal
- H: Hard
- M: Medium
- S: Soft

**SAMPLING:**

- **R. MILLER**

---

(Figure 45). Gas Content sample collection report pg 1.

(Figure 46). Gas Content sample collection report pg 2.
Coring Equipment Check List
Surface Checks

Camera
- Camera is serviceable
- Film loader
- Film developing can
- Developing solution
- Spare film

Desorber
- Stand
- Graduated cylinder
- Breaker

Core Barrel
- Bit serviceable
- Assembled
- Core Breaker O.K.
- Correct Adaptor

Other
- Bomb (N°. of)
- New drill bit
- Watch
- Record sheet
- Pen

Surveying

As a consequence of the Colliery's Outburst Management Plan it is necessary that:

"All holes drilled for the purpose of primary gas drainage
and,
"All holes drilled for the purpose of taking core samples shall be surveyed."

Surveying the drill holes allows the drainage engineer to determine the course that a particular hole has taken. From this, drainage efficiency can be predicted for a given area and additional holes drilled if necessary.

Core sample holes are surveyed to determine the location of the sample. Thus ensuring proper representation of an area in determining whether mining can proceed under safe circumstances. One illustration of the importance of surveying occurred when one core hole drilled from "Breman" ended up being over 200m away from its intended place where a core sample was required. The course of the drill hole was affected by the way the drill rig was set up relative to the cleat direction.
JOB INSTRUCTION

Department: Appin
TITLE: Surveying Bore Holes
ORIGINATOR: 
AUTHORISER:
TITLE: methane drainage engineer

JOB STEPS

1. Prepare camera and conduit.
   - Determine number of conduit lengths necessary to position camera.
   - Couple conduit into one length.
   - Position film loader onto camera, ensuring no light gets in.
   - Open slide and transfer film to camera.
   - Assemble survey tool and set timer (time delay dependent on length of hole and environmental conditions).

2. Position camera to take shot.
   - Place camera in camera capsule with the camera angle unit facing towards the end of the hole.
   - Position capsule in the hole at the desired position according to engineer's detail.
   - Holes are to be surveyed 4m from the hole collar, as some surveys are magnetically influenced by rib bolts, straps etc.

3. Allow the period set to elapse.
   - 2 minutes for standpipe orientation.

4. Remove camera from hole and develop film
   - Remove camera from capsule or torpedo.
   - Set up developing case with developing solution.
   - Position camera onto developing case to ensure no light.
   - Critical: Transfer film from camera to developing case.
   - No light permitted.
   - Allow developing time 1 minute.
   - Remove disk from developing case.
   - Over exposed - disk all black.
   - Under exposed - disk is clear (timer malfunctioned or batteries flat).

REMEMBER

The Eastman Survey Camera is a highly sensitive instrument and should be handled with extreme care.
Cross - Measure Drilling

Cross - Measure Geology

There are several seams below the Bulli Seam, (refer Figure 51 on page 154). These seams can reach inherent gas contents up to 16m³/ft³.

The idea of cross measure drilling is to capture the gas liberated when the longwall advances. This is called "post drainage".

When the longwall is mined, the strata breaks up below the newly formed goaf. The depth of the strata breakage extends down to about the Wongawilli Seam level.

On occasions when strata failure involves the Wongawilli Seam, significant volumes of methane are released. Flow rates from these holes begin to increase at approximately 0.5 metres in front of the face and will peak at approximately the face. These peak flows average 550 l/sec from a set of ten holes, but may vary between 20 and 800 l/sec for an individual hole. These flow rates are only made possible by the proper use of adequate casing. Flow rate decreases as the face progresses. Methane purity from down holes averages 93%.

Mining rate, geological structures, horizontal stress magnitude and rock strength are all likely to be factors in controlling this gas release process.

(Figure 47). Drilling Rig (KEMPE. K200) Used for Cross-Measure Drilling