Coal bursts overview

25/11/15

Brad ELvy

Overview

- Recent significant coal burst events resulting in fatalities
- Mines are getting deeper with more challenging conditions
- ACARP Underground committee members decided to proactively seek research into coal bursts.
- ACARP formed a Coal burst task group made of members from interested companies.
- Initial ACARP Project – Coal burst Scoping Study

ACARP Coal Burst Task Group

- Brian McCowan – Glencore
- Bharath Belle – Anglo American
- Roger Byrne – South32
- Brad Elvy – South32

Scoping Study Group

- Prof Ismet Canbulat (UNSW Australia)
- Prof Bruce Hebblewhite (UNSW Australia)
- Emeritus Prof Jim Galvin (UNSW Australia)
- Associate Prof Serkan Saydam (UNSW Australia)
- Associate Prof Paul Hagan (UNSW Australia)
- Prof Fidelis Suorineni (UNSW Australia)
- Dr Rob Thomas (Golder Associates)
- Dr Baotang Shen (CSIRO)
- Dr Winton Gale (Strata Control Technology)

Project work program

1. Review and document coal burst knowledge

   - ***agree on a set of Australian Definitions***

2. Evaluation of past research

3. Recommended members for a steering committee

   - ***to enable guidance in research areas***
   - ***provide peer review of research***

4. Conduct industry workshops.

5. Final report

   - ***recommendation for further research***

Discussion on the relationship between coal bursts and outbursts

25/11/15

Jeff Wood

Definitions

Outburst

A sudden release of gas and material from the working place that can vary in magnitude and intensity.

(MDG1004-Outburst mining guideline)

Outburst Parameters

- High Gas Content (and therefore Pressure)
- Large volume of gas involved
- Hard coal – spitting at face
- Finely divided material ejected
- Usually associated with structural disturbance

- Energy release by adiabatic expansion of stored gas within the coal mass

Definitions continued

Pressure bump

A dynamic release of energy within the rock mass that is of sufficient magnitude to generate an audible signal; ground vibration and the potential for the displacement of loose or fractured material into the mine workings

Pressure burst

A pressure bump that results in dynamic rock failure in the vicinity of a mining excavation resulting in high velocity expulsion of the failed material into the excavation

Coal Bursts

- It is generally accepted that a high risk of coal burst exists where a coal seam is surrounded by hard massive rock strata and under high overburden and/or tectonic stresses.

- The presence of geological structures is also considered as a key contributing factor.

Coal Burst Parameters

- Relatively small amount of gas involved
- High stress inferred
- Stiff coal
- Spitting of coal
- Coarse material ejected

- Energy release of stored strain energy within the coal mass

Energy Approach

- Strain Energy is that energy stored within the coal in response to the local stress field under conditions of zero lateral strain
  - The magnitude of this strain energy is dependent on the stress field and the elastic properties of the coal (and immediate roof and floor material)

- Confinement is that stress provided by the surrounding coal to prevent horizontal strain

Energy Approach

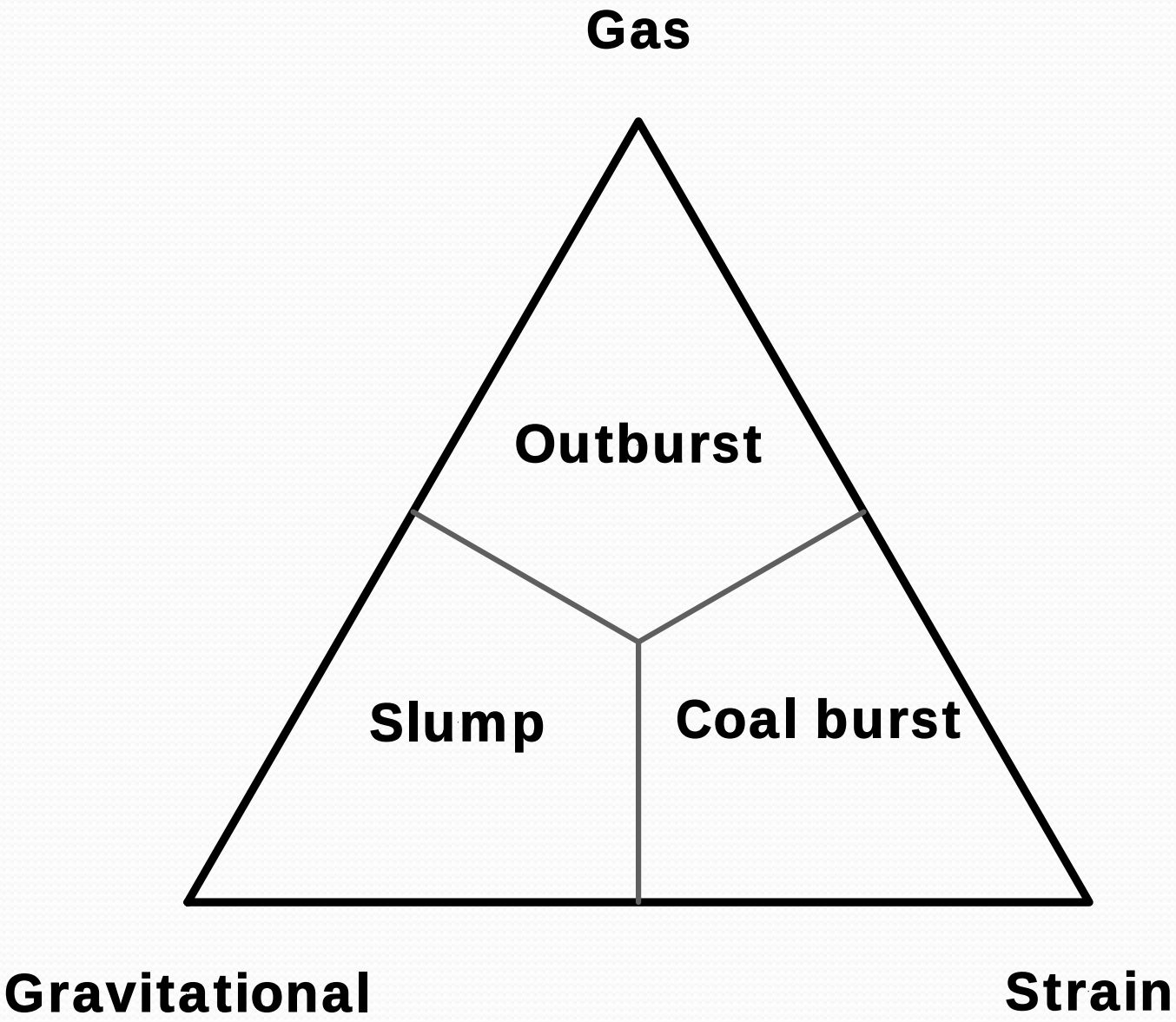
- Gas energy is a function of the gas pressure held within the free space (porosity and fracture system) of the coal seam.

- During dilation due to the advance of a development face the free space increases and the gas pressure at any instant is a function of the ability of the coal to provide gas due to a diffusion process

Coal Bursts

- Usually associated with the formation of pillars. A function of the width/height ratio as used in pillar stability calculations. This is associated with the vertical stress conditions, coal stiffness and roof and floor stiffness

- A similar situation exists when developing in high stiffness coal towards (or past) a fault zone of low stiffness – stress concentration in the immediate face area (analogous to a narrow pillar)


Gas
Outburst
Slump
Coal burst
Gravitational
Strain

Influence of geological structure

- Geological structure is a result of failure and stress redistribution in the solid coal mass
- Stress redistribution may result in an anomalous horizontal stress (either low or high) in the vicinity of the structure
- Igneous bodies such as dykes or sills may increase the stiffness of surrounding strata and hence increase the (usually horizontal) stress bearing capacity of this strata

Conclusions

- Outbursts are associated with gas energy
- Coal bursts are associated with strain energy
- Outbursts and coal bursts are types of fragmenting failure during a reduction in confinement
- Bumps are the result of stress redistribution within the strata
- Coal slumps are a product of failure of already stress relieved (non stress bearing) material with little confinement
- Coal bursts and gas bursts are linked

Further Study

- Prediction of zones of high stress and stiff coal
- Methods for the measurement of stress – both magnitude and direction
- The effect of low horizontal stress on confinement
- Effective stress and its relationship to coal stiffness
- Coal shrinkage during gas drainage
- The relationship between stress-coal stiffness and difficult to drill (boggy zones)
- Microstructure in coal

Thank You