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CSIRO CMM Research

Dr Hua Guo
Advanced Coal Technology



The Commonwealth Scientific and Industrial Research Organisation (CSIRO)

- Is Australia's national science agency and largest scientific enterprise
- Has an annual budget of more than \$1.3 billion
- Employs 6,500 staff

Australian Coal Industry Overview

Secure, reliable and competitive supplier

World's largest exporter – about 28% of world coal market in 2008-09

2009-2010 coal production statistics

raw black coal: 471Mt

saleable black coal: 366Mt

2008-09 exports: 261Mt (\$A55 billion)

Black and brown coal account for 80% of Australia's electric power
(with black coal accounting for 57%)

Australian Coal Mining Fugitive Emissions

Total fugitive emissions from coal mining 29 Mt CO₂-e during 2009 which is about 5% of national total GHG emissions (DCCEE, 2011)

Sources of coal mining fugitive emissions:

- 61% underground mining operations
- 31% open-cut mining
- 8% post-mining and decommissioned mines

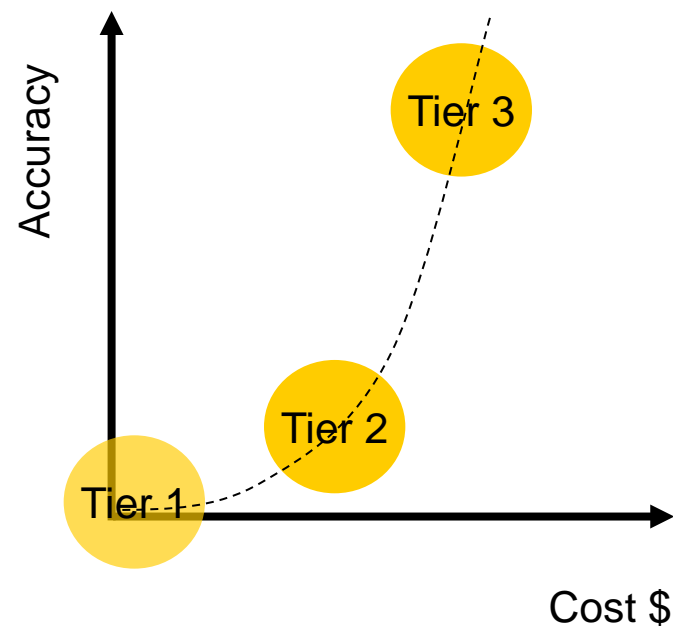
CSIRO CMM Research - Key Areas

- Surface and underground coal mine gas emission measurement and estimation methods
- CMM capture or drainage maximisation
- VAM mitigation and utilisation

Estimating Fugitive Emissions From Open Cut Mining

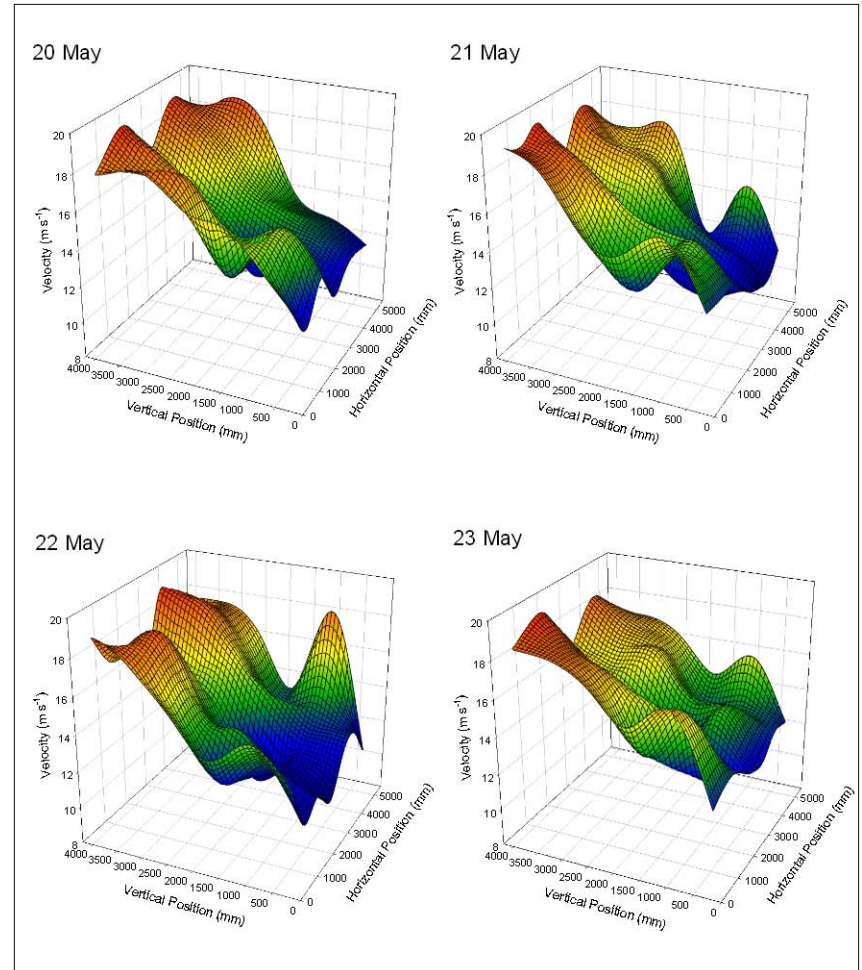
Coal mine emissions are traditionally expressed in terms of specific emissions: volume of gas emitted per tonne of coal extracted (m^3/t), Emission Factor (EF).

- Tier 1 –Generic EF for mining
 - very rough (~ 0.5 to $1 \text{ m}^3/\text{t}$)
- Tier 2 –Basin specific
 - improved but preliminary
- Tier 3 –Mine specific
 - reasonably accurate.



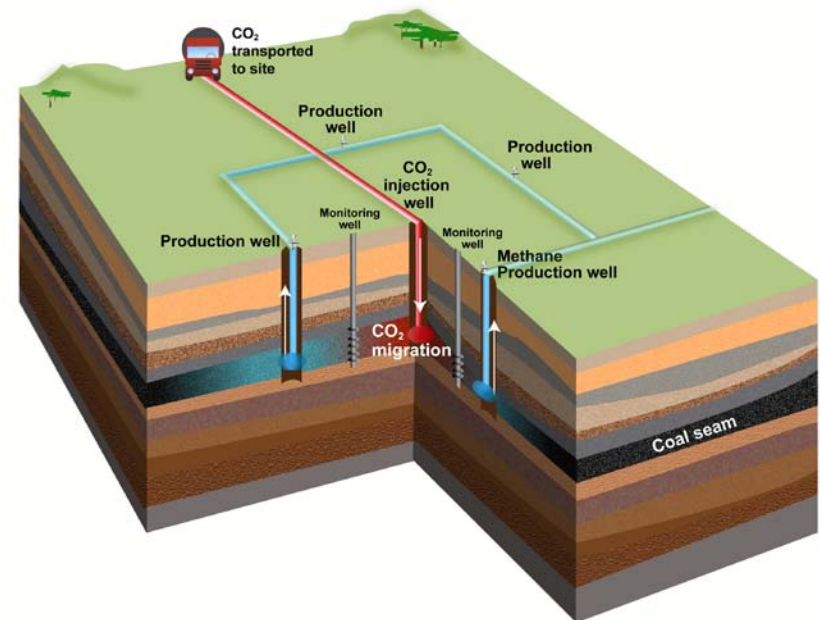
Measurement Techniques For Underground Mines

- Pitot probe
 - Accurate measurements
 - Significant velocity profile

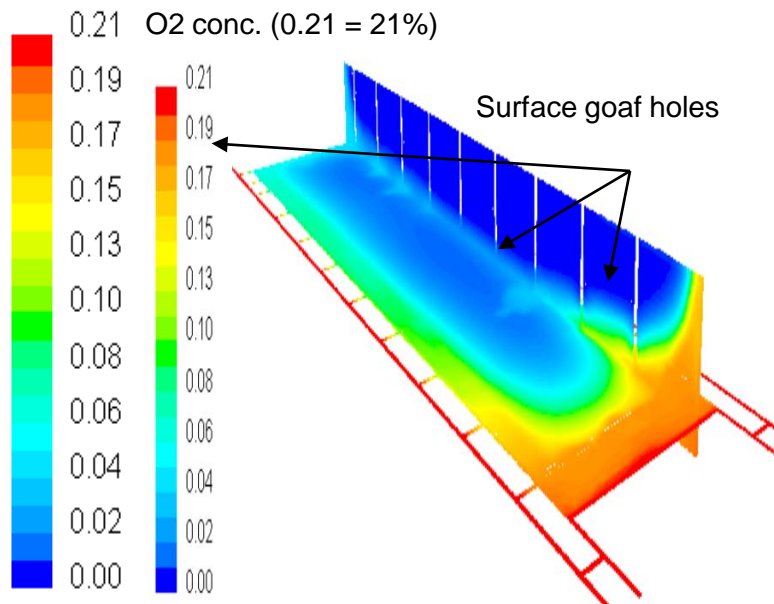


Developing ECBM for Enhanced Methane Capture

- CUCBM (China), CSIRO and JCOAL are carrying out an ECBM field trial under the Asia Pacific Partnership
- Targeted coal seams are at ~500m, at Liulin Gas Block, Luliang City, Shanxi Province
- The injection well is a multi-lateral horizontal well with ~3.5km length
- Field trial to be completed before the end of 2011



CSIRO Surface Goaf Gas Drainage



Drainage simulation and design

Techniques

- Design of optimal drainage systems (number of holes, size, and location)
- Equipment selection and drainage operations

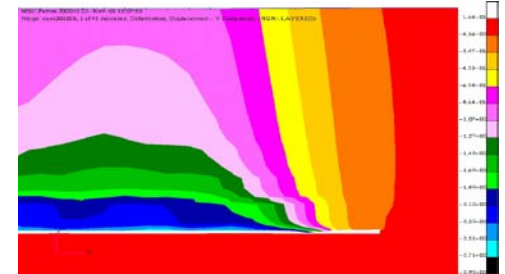
Outcomes

- 50% - 200% increase in gas capture
- Production increase in Australian mines

Integrated Coal and Methane Extraction

CSIRO Software COSFLOW

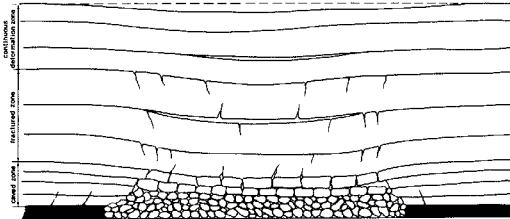
Mining induced strata fracture/deformation



Vertical Displacement



Change in permeability and reservoir pressure



Caved, fractured and deformed zones



Change in effective stress

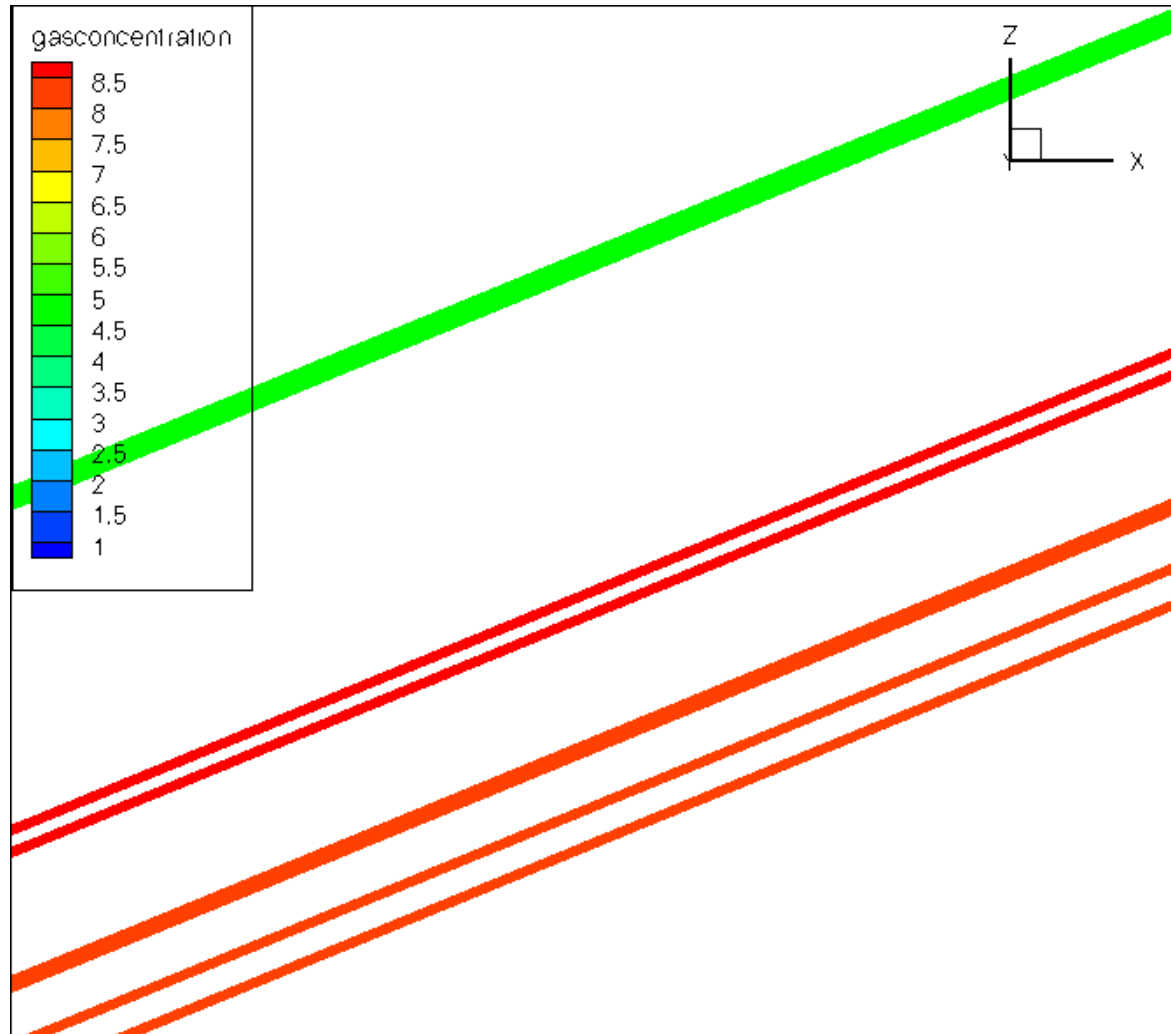
Ground Water Flow

Change in reservoir pressure and relative permeability

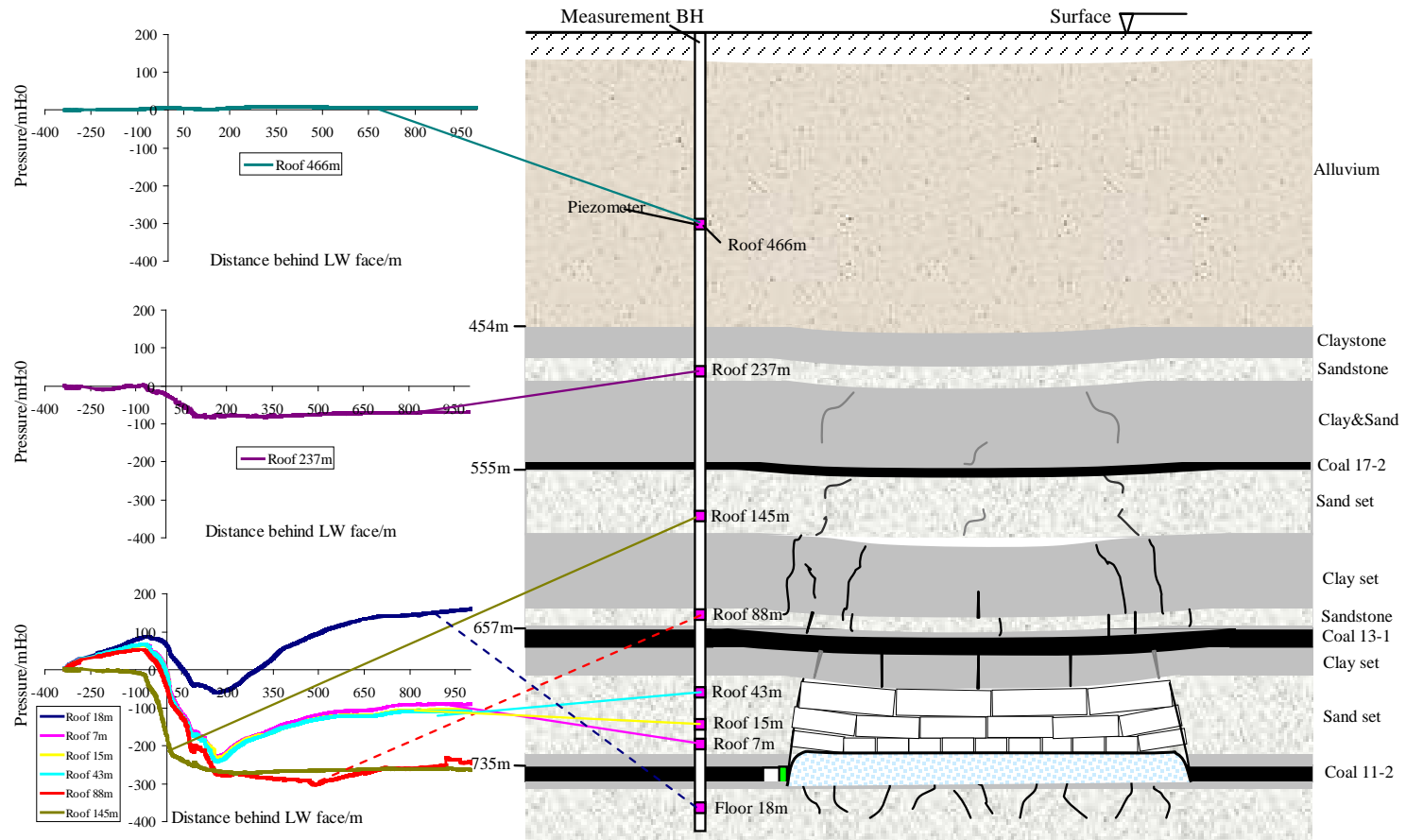
Gas diffusion and flow



Multi-Seam Gas Flow and Emission Simulation - COSFLOW



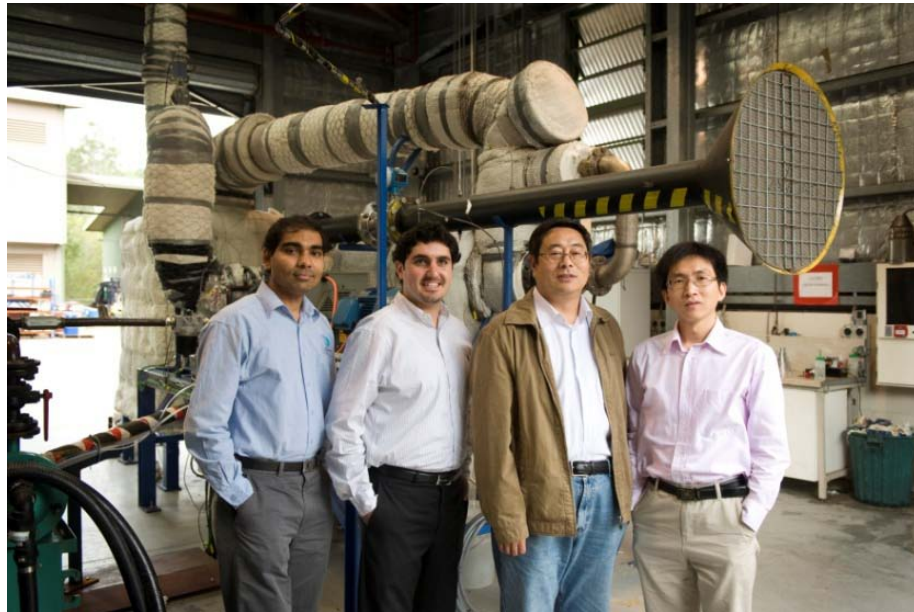
Integrated Coal and Methane Extraction of Deep and Multi-Seams



Overburden strata fluid pressure monitoring during mining at Huainan China

VAMCAT Technology

- A new lean burn catalytic combustion gas turbine system, which can be powered with about 1% methane in the air
- Developed for the mitigation and utilisation of low concentration methane in mine ventilation air and poor drainage gas



VAMCAT 25kWe demonstration unit at QCAT

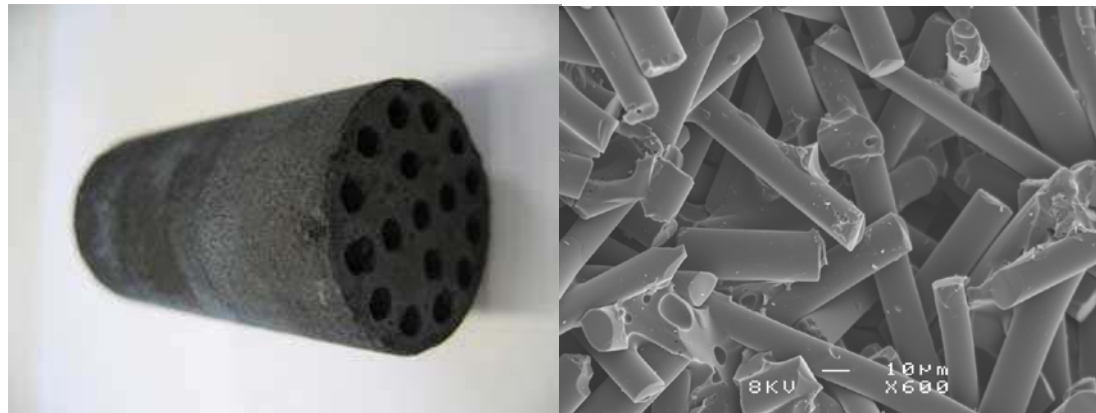
VAM Capture Research

Goal

To develop an innovative technology of concentrating mine ventilation air methane (VAM) to high concentrations of $\geq 30\%$, or to levels that meet the requirements of lean-burn gas turbines.

Innovative technology

Nano-structured carbon fibre composite adsorbents, fabricated in honeycomb monoliths, enable the CH_4 capture in a dry process, high dust environment with low pressure drop.

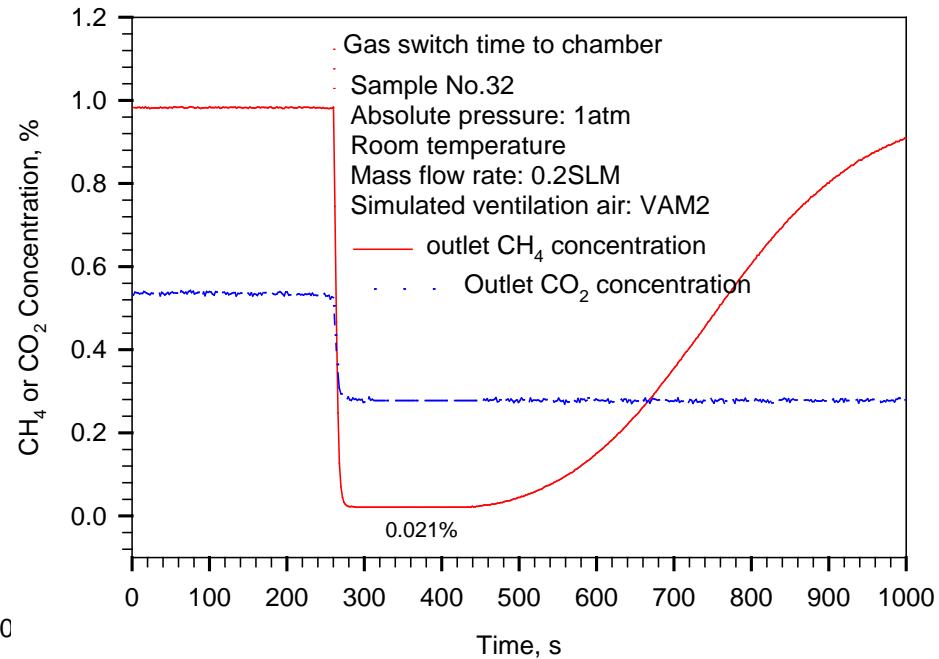
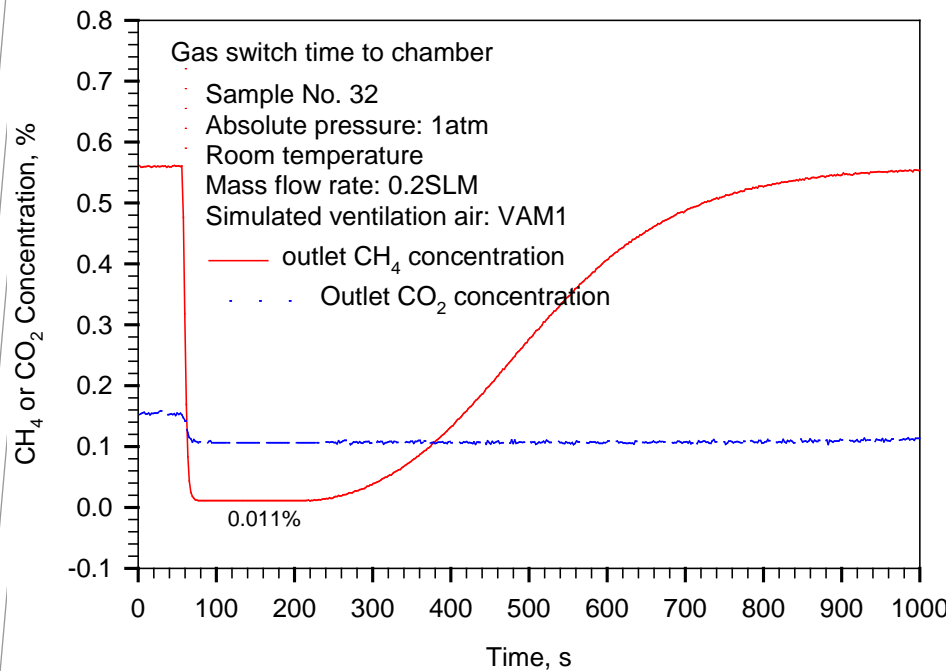


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VAM Capture Technology (Continued)

Lab scale study results

Adsorption breakthrough: more than 95% of the methane captured from both simulated VA.



Adsorption breakthrough test with simulated VAM1 & VAM2

Closure

- CSIRO has undertaken a wide range of CMM research over the last 20 years
- CSIRO has successfully developed advanced CMM technologies and delivered significant benefits to the coal industry
- Several key new CSIRO CMM and VAM technologies will be trialled at mine sites over the next few years

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Coal Production

Dr Hua Guo
Theme Leader

Email: hua.guo@csiro.au
Web: www.csiro.au/cesre

www.csiro.au

Thank you

