Re-entering a sealed heating:

How gas indicators change

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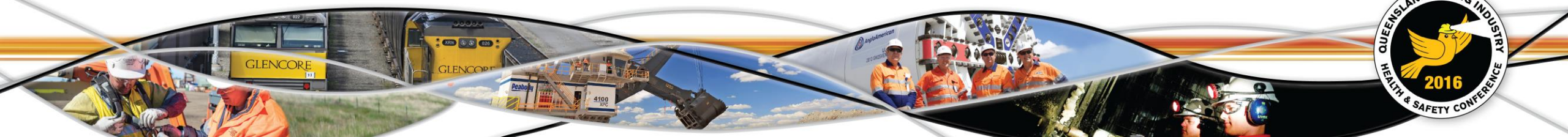
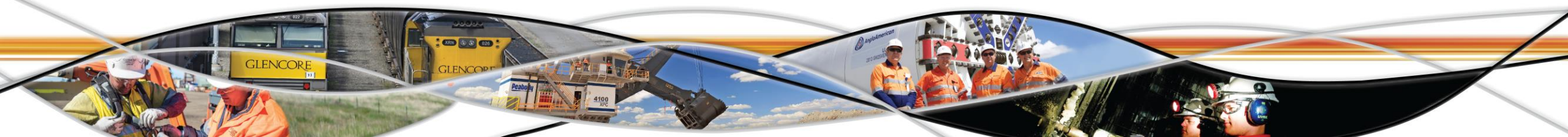
Project Officer

Simtars



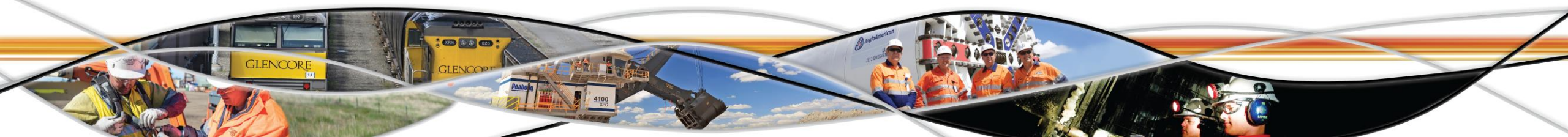
Outline

- Background
- Test Equipment
- Permanent Gases
- Natural Gases
- Volatile Organic Carbons
- Aldehydes
- Conclusions



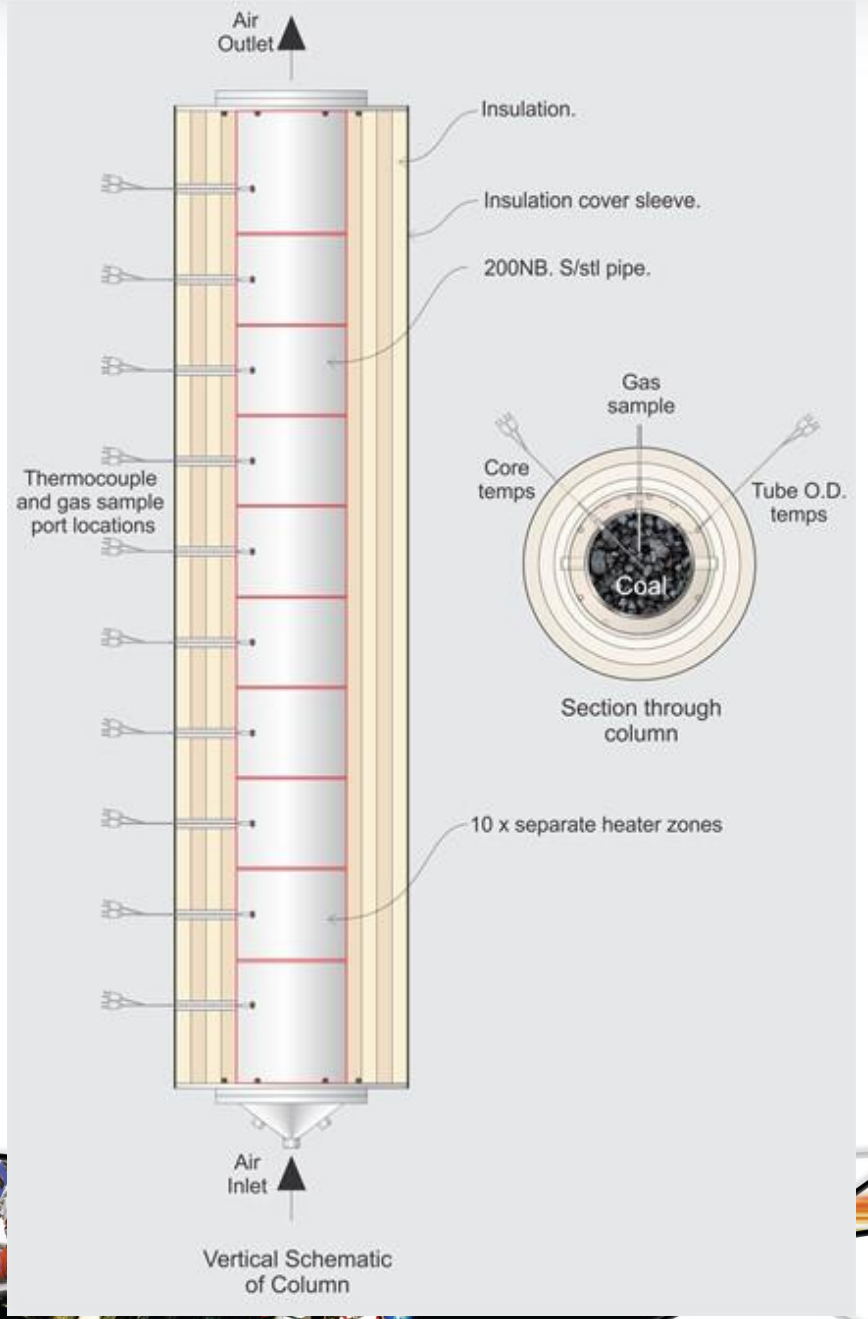
Background

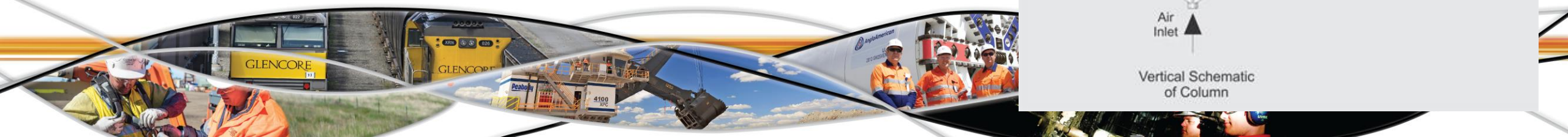
- Coal self-heating events remain a significant problem
- Volatile Organic Carbons (VOCs) and/or aldehydes provide an indication of coal temperature
- Small scale tests show inertisation of coal affects the gas indicators when re-exposed to oxygen



Test Equipment

- 2-Metre Column
- Sample: ~50 kg of sub-bituminous coal
- Heating Mode: Step Heated in 5 °C increments
- Step Duration: 24 h – 48 h

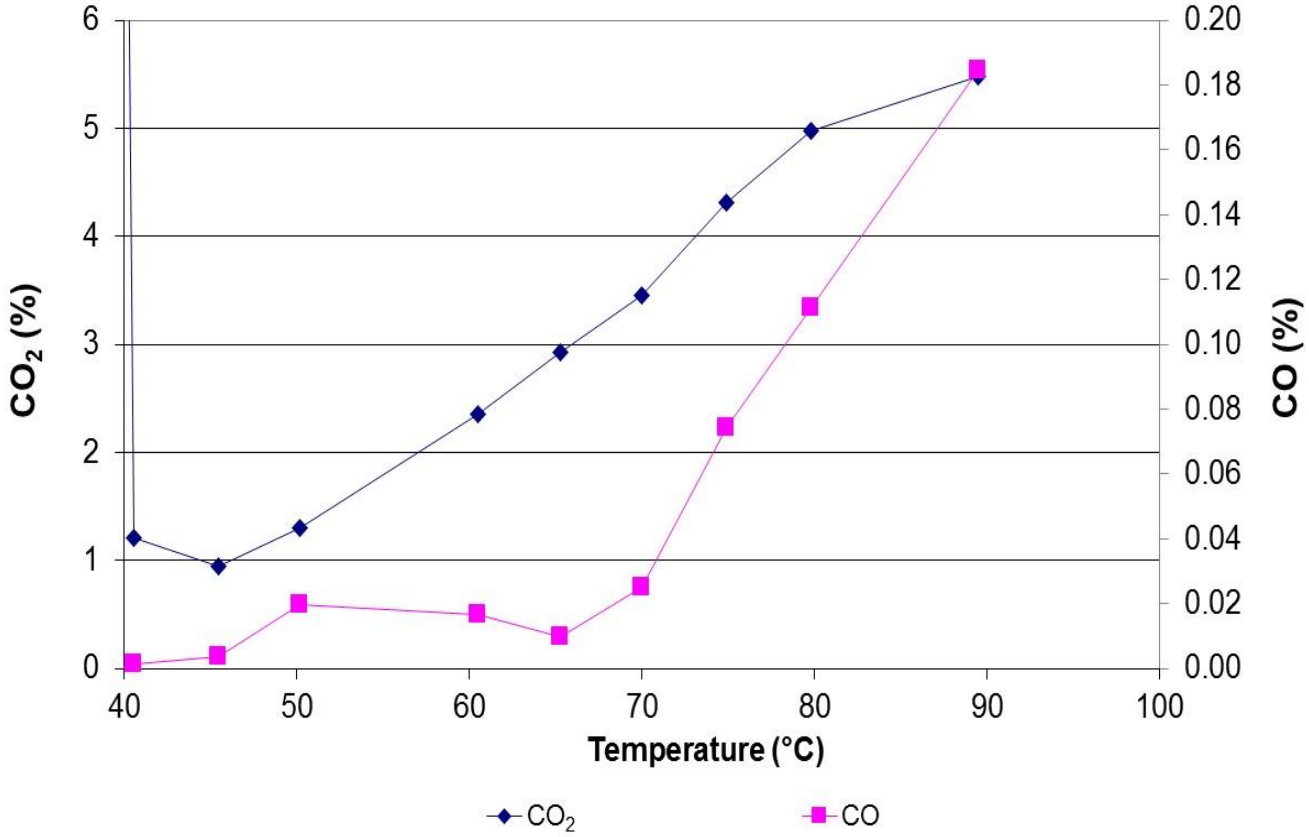


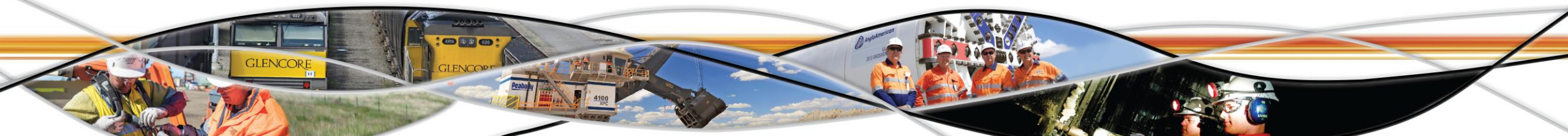


Permanent Gases

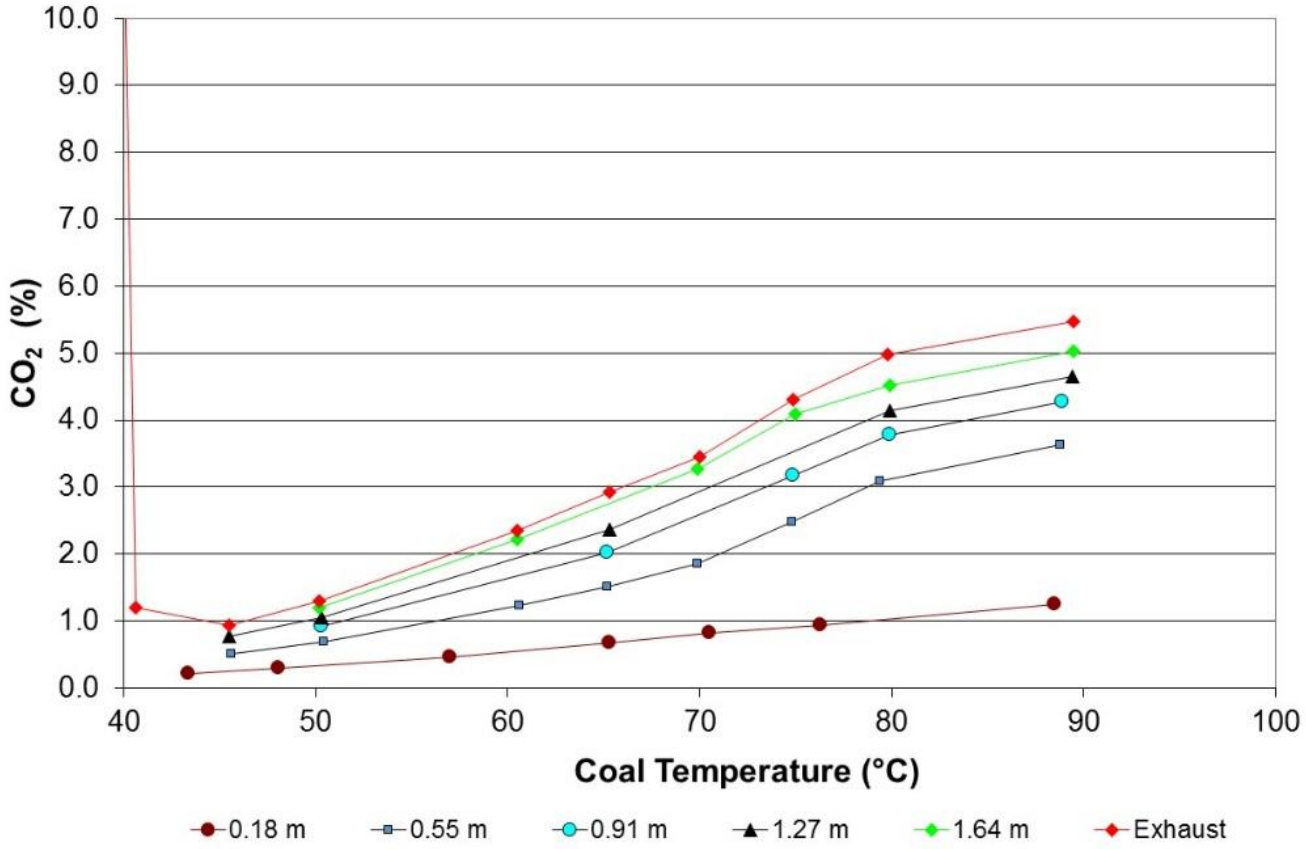
- Carbon Monoxide (CO)
- Carbon Dioxide (CO_2)
- Helium (He)
- Oxygen (O_2)
- Methane (CH_4)
- Ethane (C_2H_6)
- Ethylene (C_2H_4)
- Hydrogen (H_2)

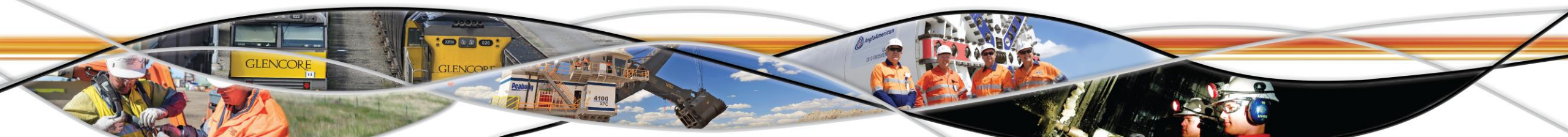
Permanent Gases: CO and CO_2



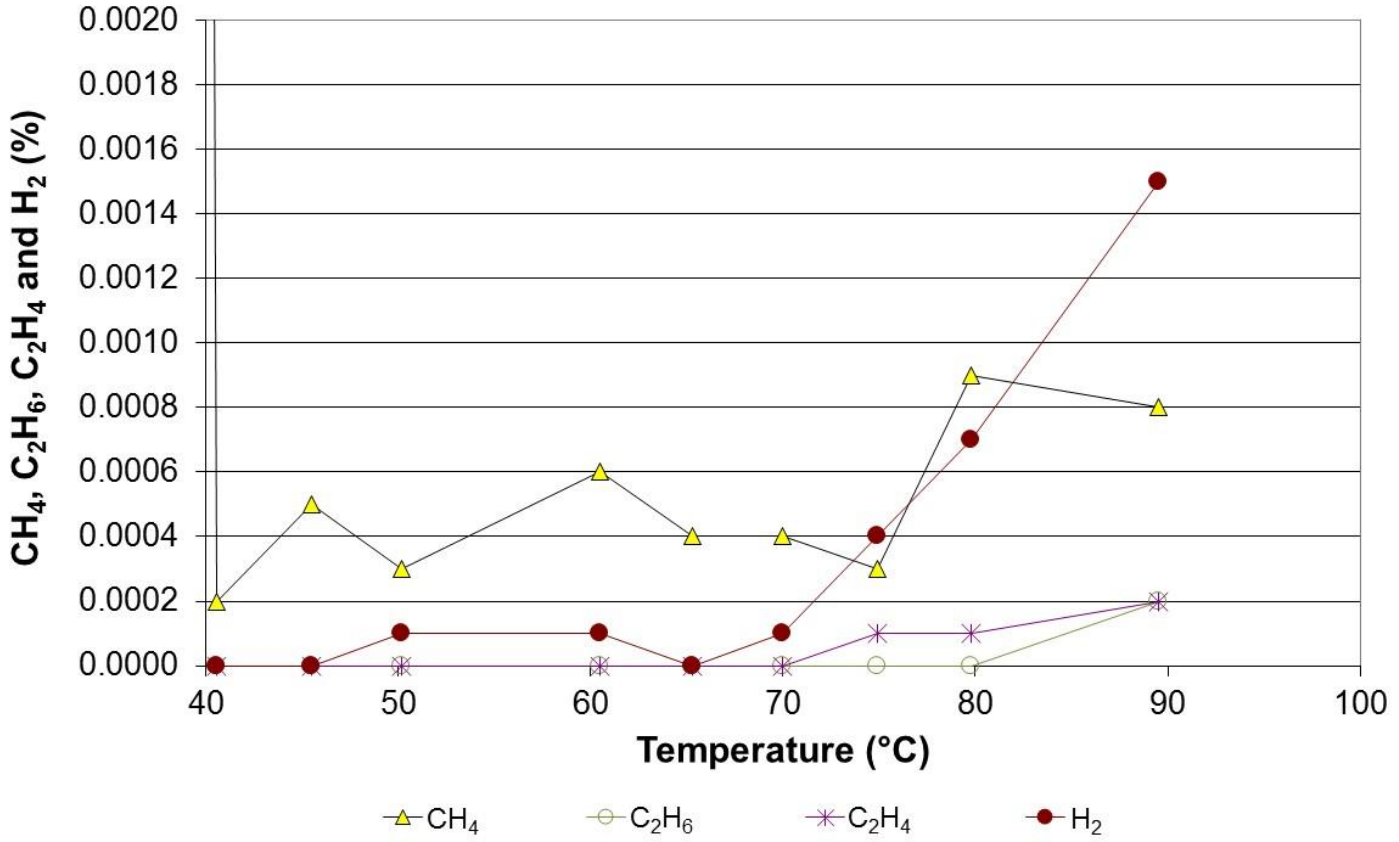


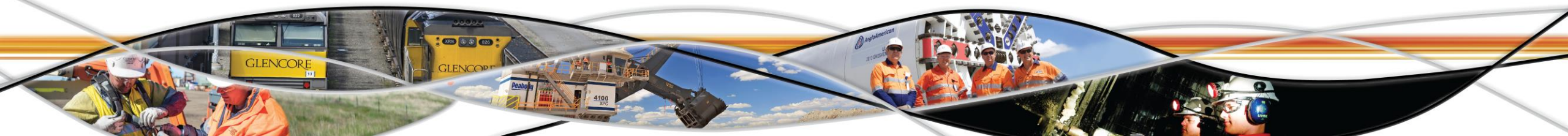
Permanent Gases: CO_2 Profile



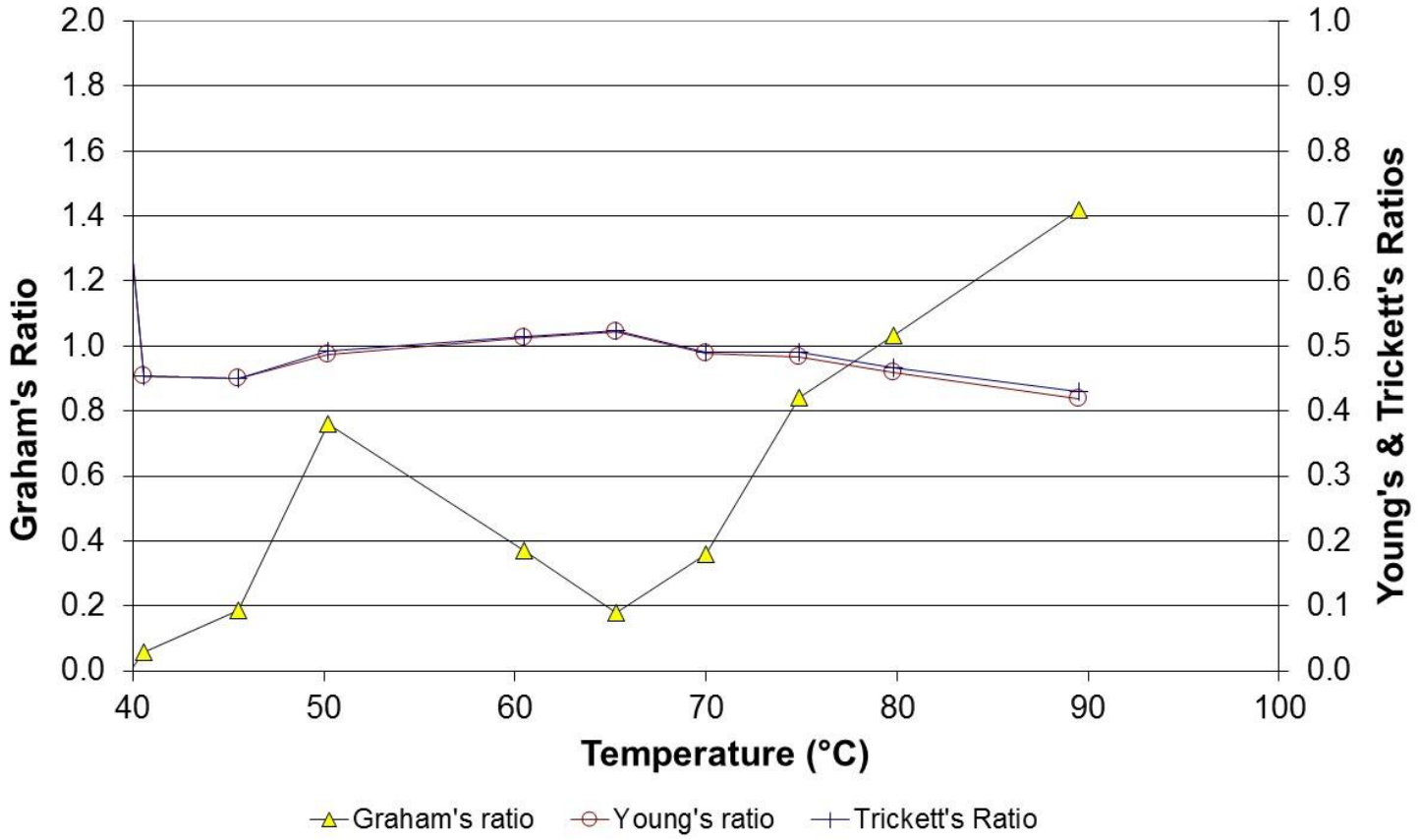


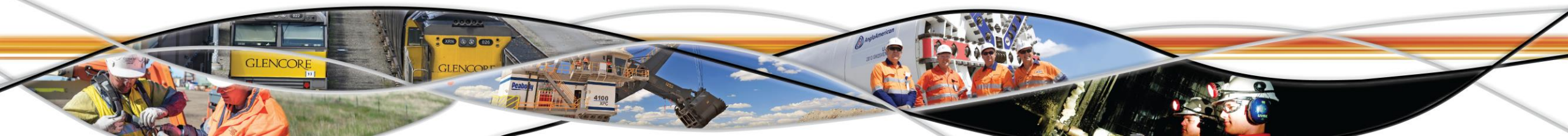
Permanent Gases: CH_4, C_2H_6, C_2H_4 and H_2



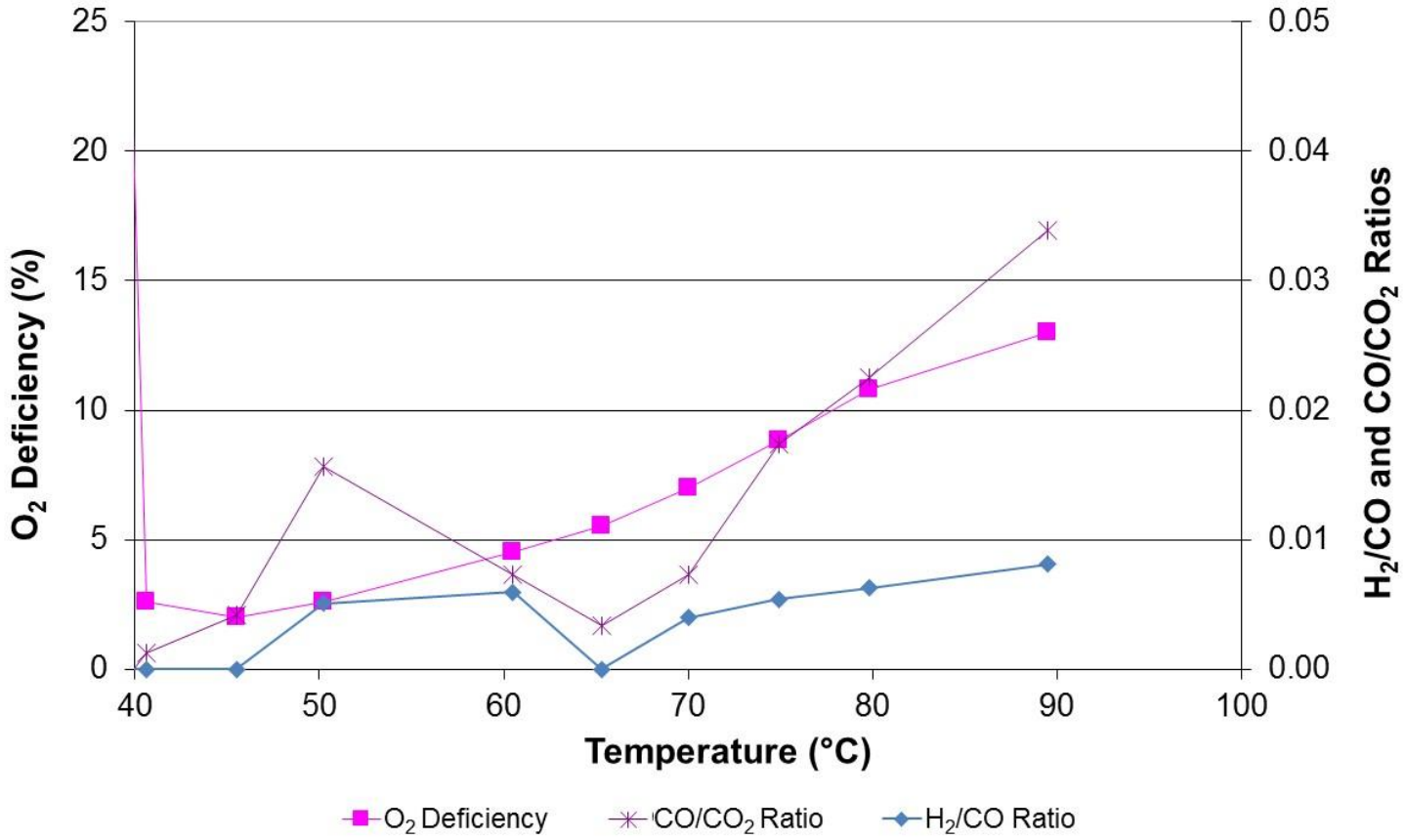


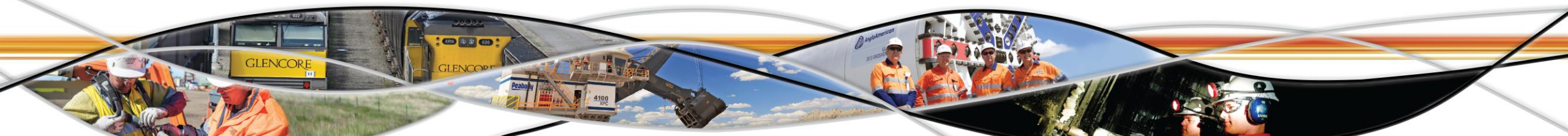
Permanent Gases: GR, YR and Trickett's Ratio



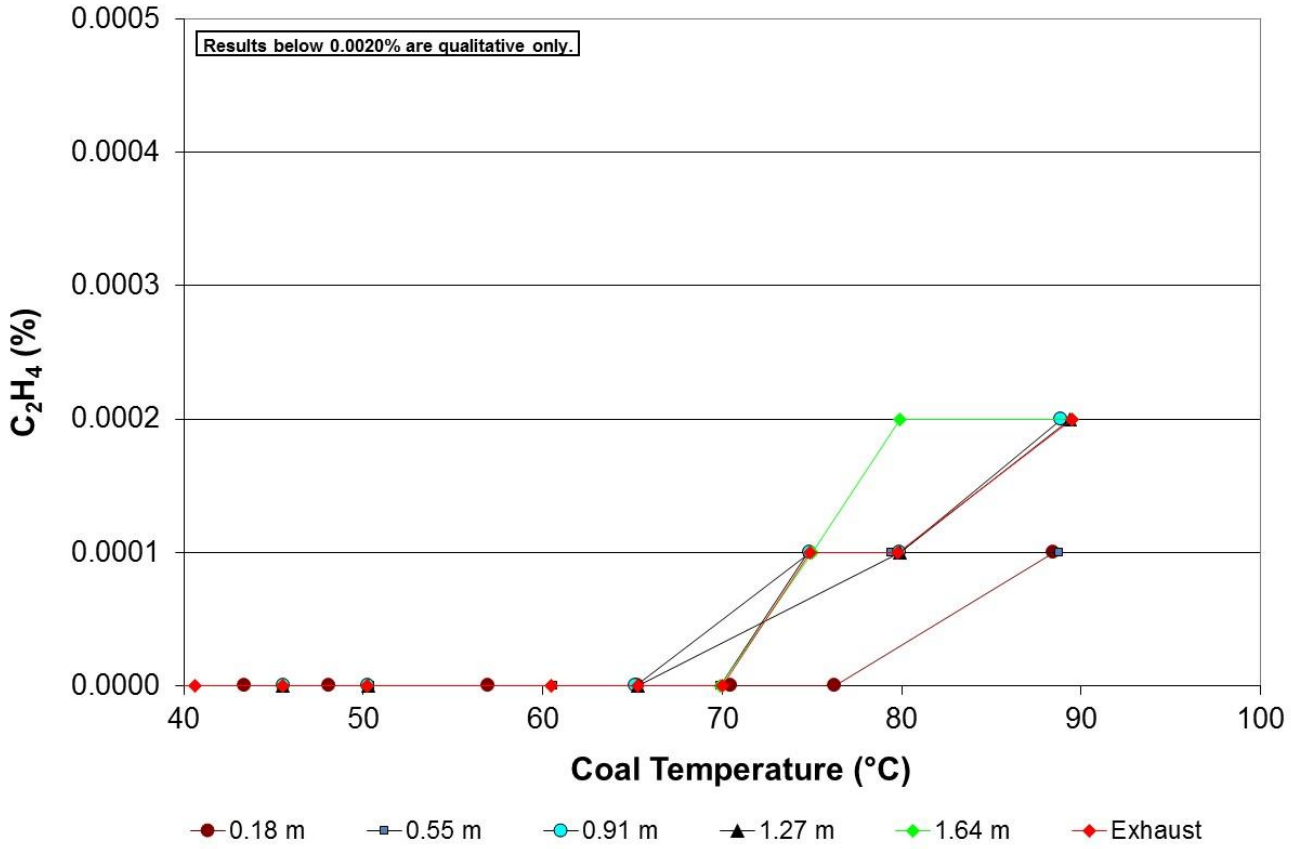


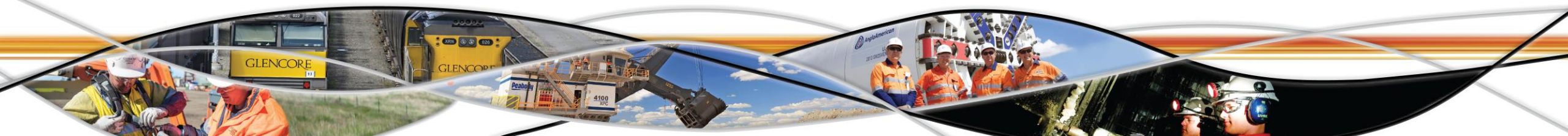
Permanent Gases: O_2 Def. CO/CO_2 and H_2/CO





Permanent Gases: Ethylene



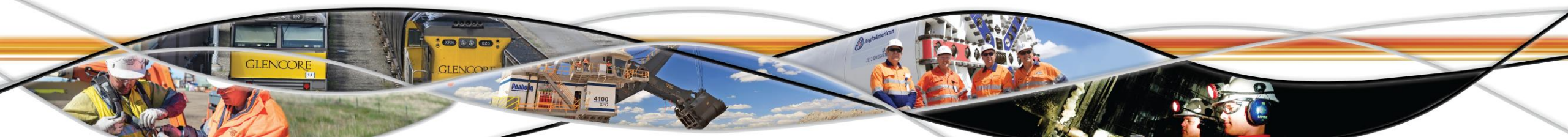


Natural Gases

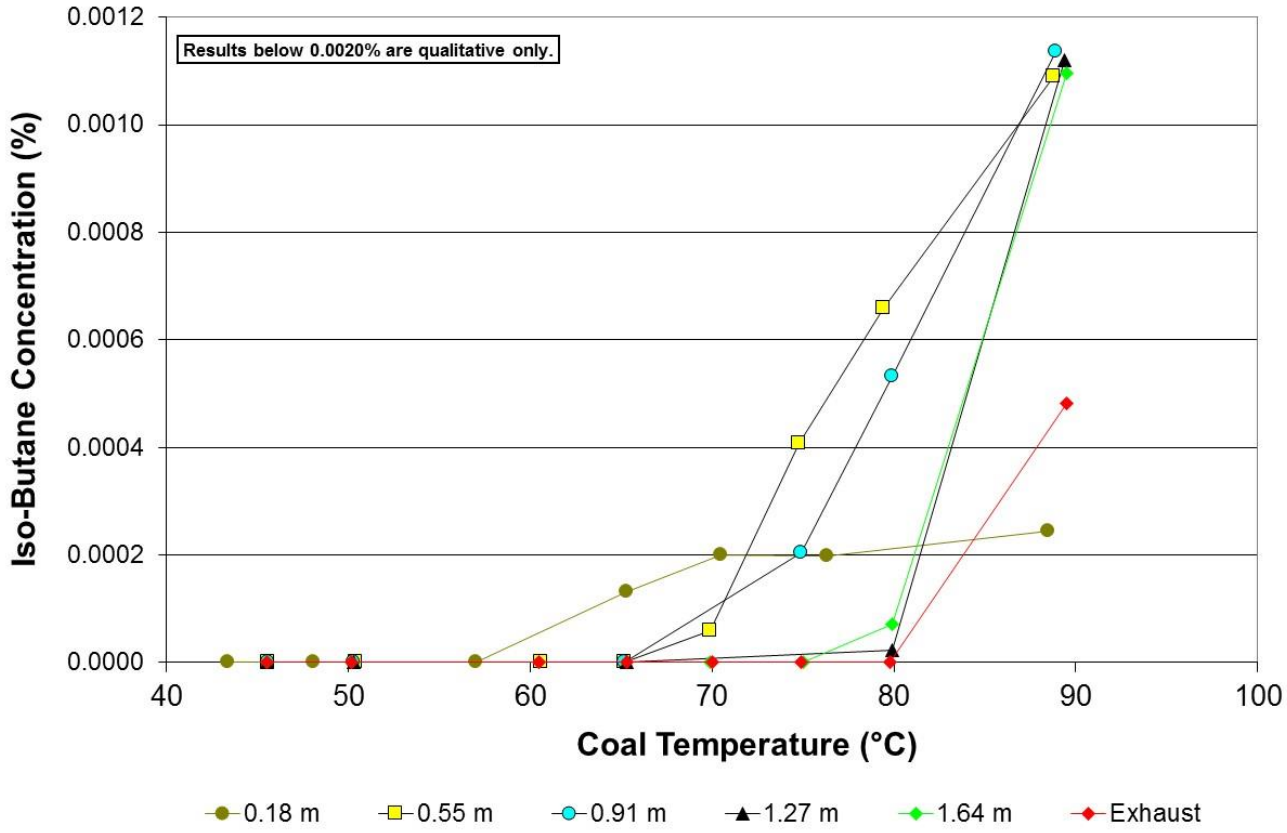
Analysis Equipment: Agilent CP490 micro gas chromatographs

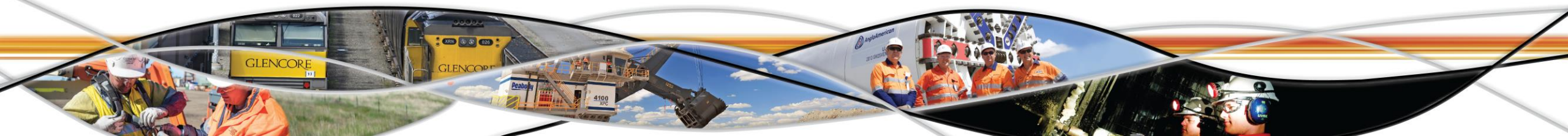
Gases Analysed

- Propane
- Iso-Butane
- N-Butane
- Neo-Pentane
- Iso-Pentane
- N-Pentane
- Hexane

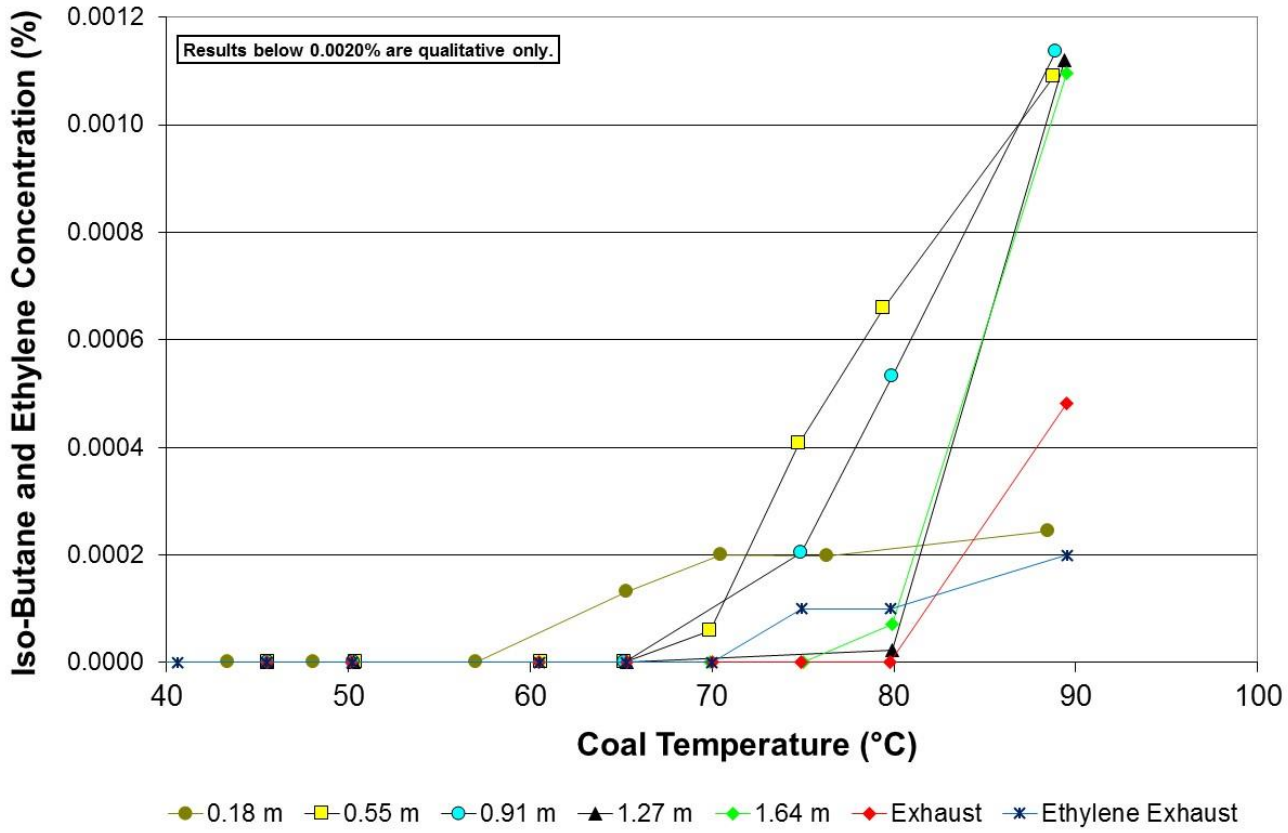


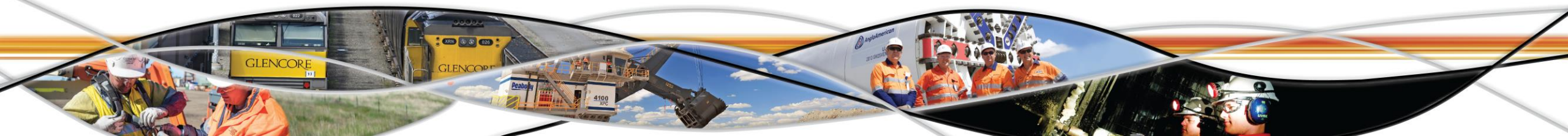
Natural Gases: Iso-Butane



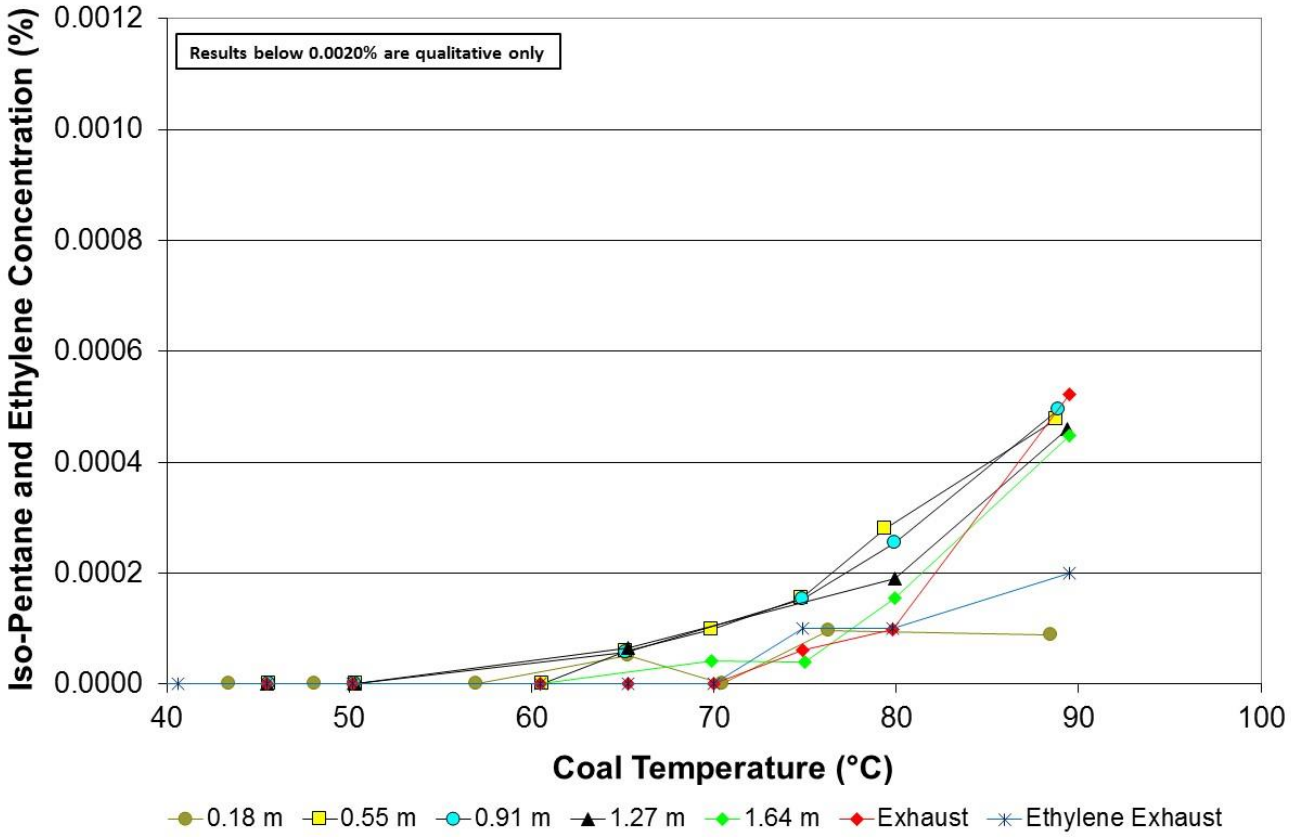


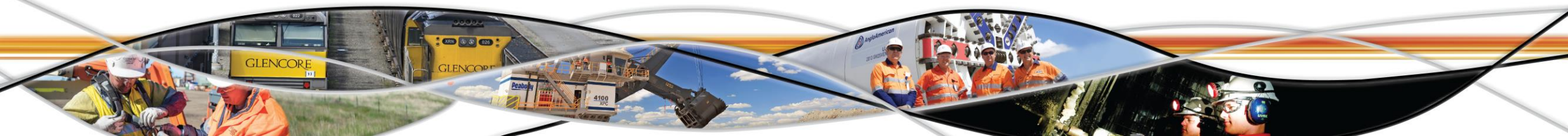
Natural Gases: Iso-Butane and Ethylene





Natural Gases: Iso-Pentane and Ethylene





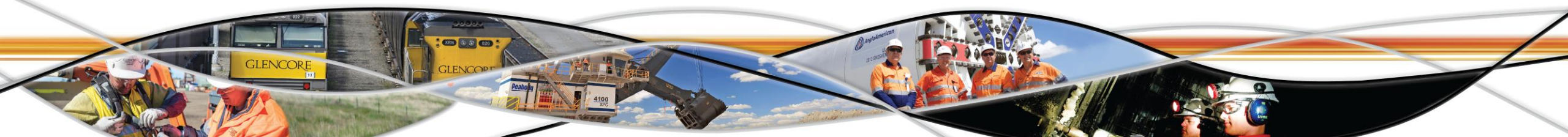
VOCs and Aldehydes

Sorbent Tubes

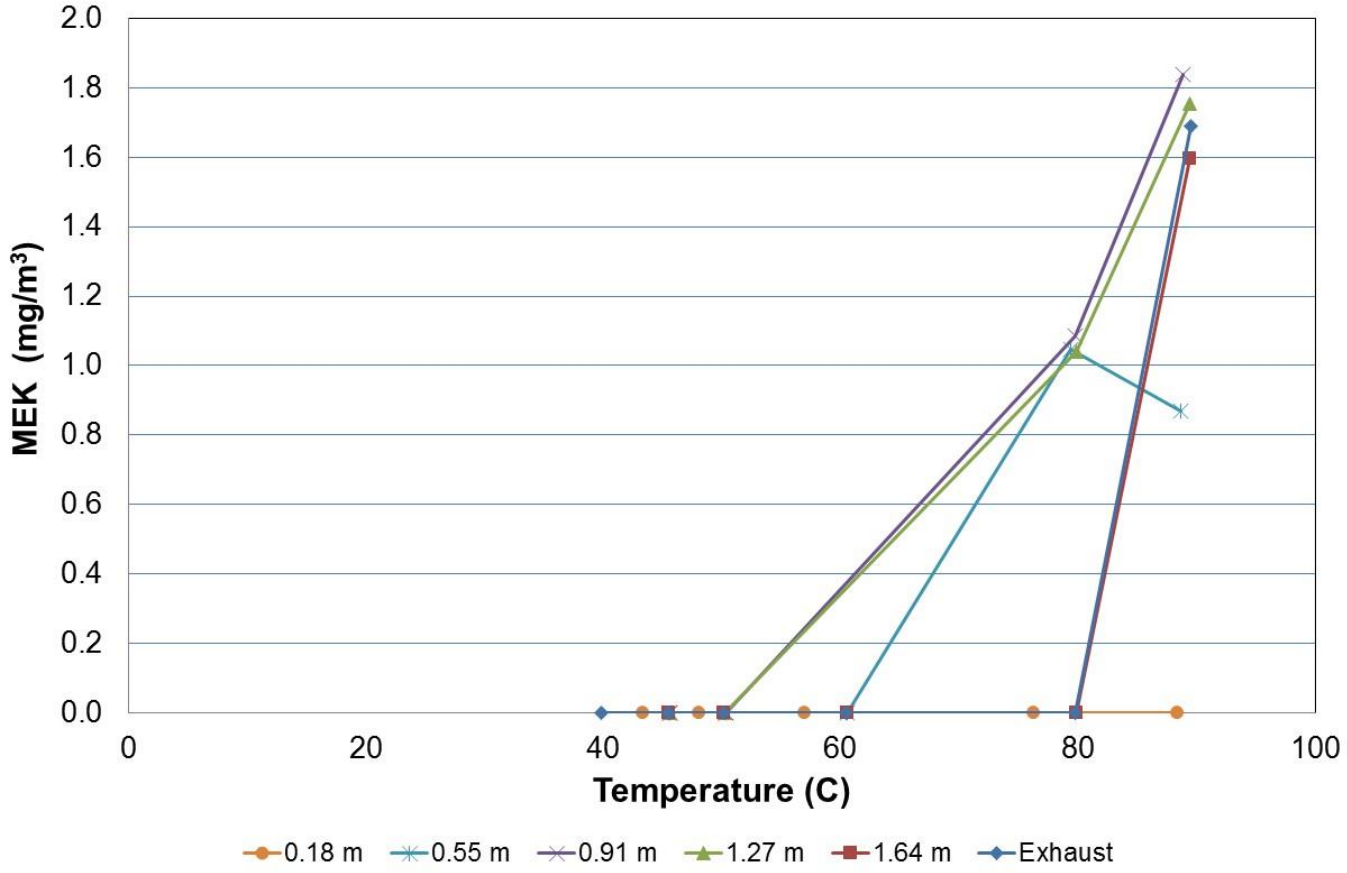
- Aldehydes: SKC Sorbent Tube 226-119
- VOCs: SKC Sorbent Tube 226-01

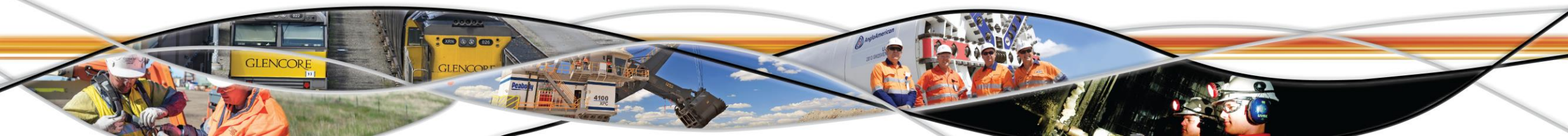
Analysis Method

- High performance liquid chromatography

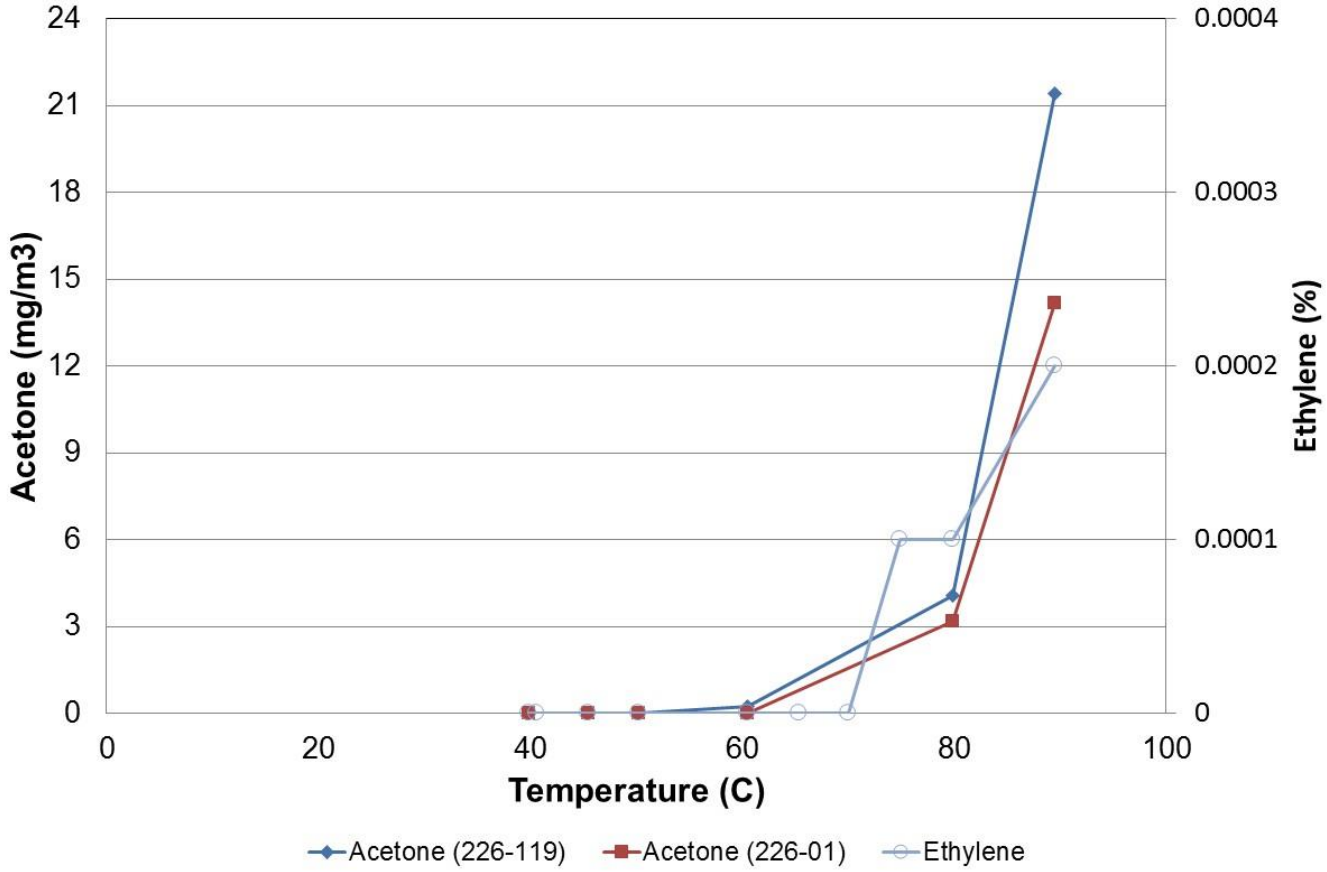


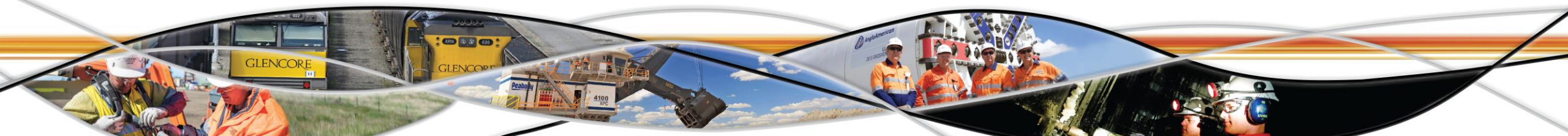
VOC and Aldehydes: MEK



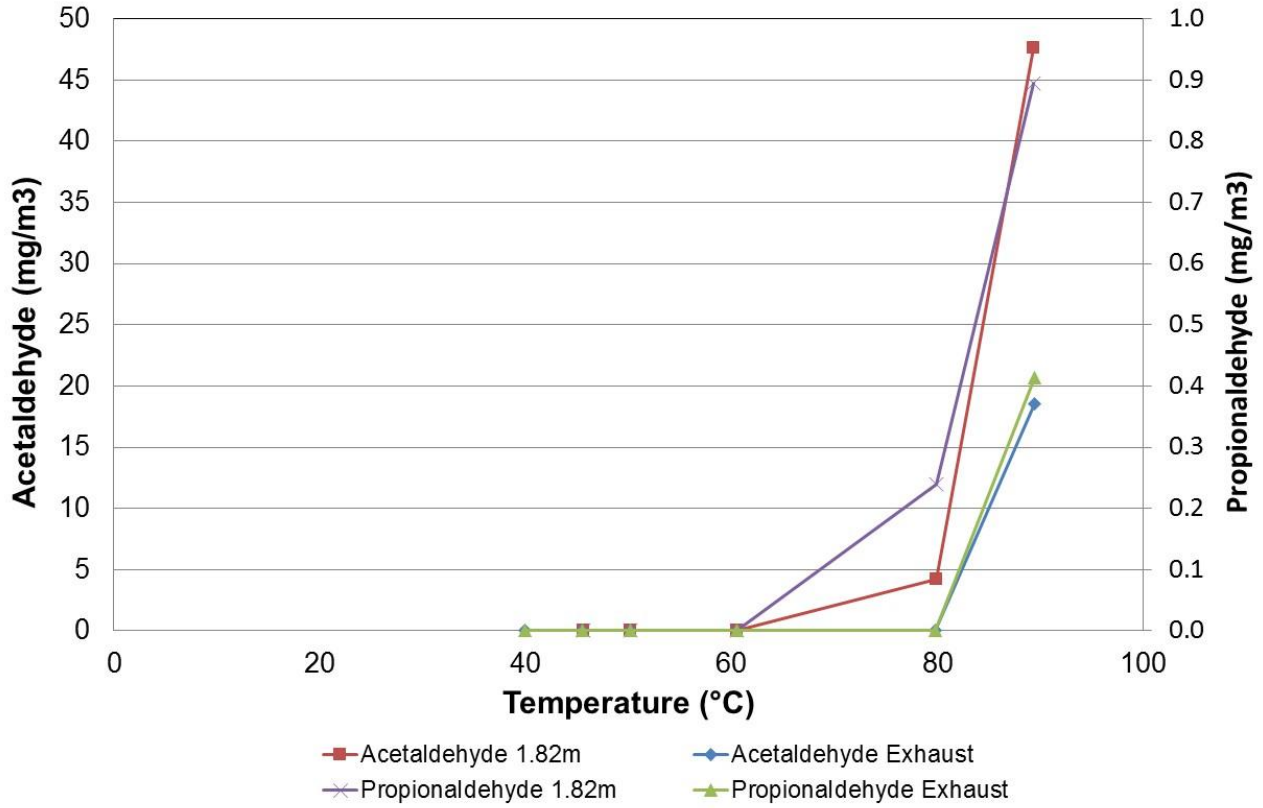


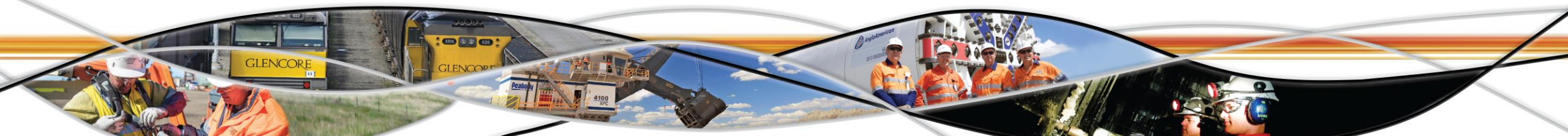
VOC and Aldehydes: Acetone and Ethylene





VOC and Aldehydes: Acetaldehyde and Propionaldehyde

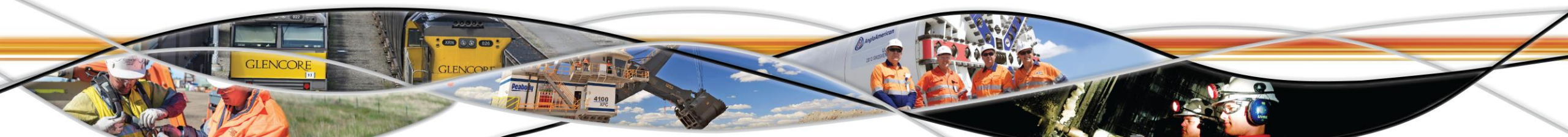




Conclusions

2 – Metre column has demonstrated the following

- Iso-butane and iso-pentane are detected at coal temperatures above 65 °C
- Iso-butane and iso-pentane are more responsive to increasing coal temperature than ethylene
- Coal or moisture may remove natural gases, VOCs and aldehydes from the air stream
- High moisture content blocks oxygen reactive sites and inhibits coal oxidation
- Future research into the effect of inertisation on the gas indicators



Thank You