

Placing propped hydraulic fractures for stimulating underground in-seam gas drainage holes – techniques and results

Rob Jeffrey
CSIRO Petroleum & Geothermal
rob.jeffrey@csiro.au
03 9545 8353

Introduction

- Sand propped hydraulic fractures have been successfully placed into in-seam drain holes at Dartbrook, West Cliff and United. These trials increased gas drainage rates by factors varying from 5 to 180 times.
- Below depths of 300 to 350 m, borehole conditions become more difficult with holes breaking out because of stress. Casing the holes before fracturing can be used for these deeper conditions.
- Methods to install and cement casing have been developed.
- Methods to slot through the casing and fracture into the slots have been developed.

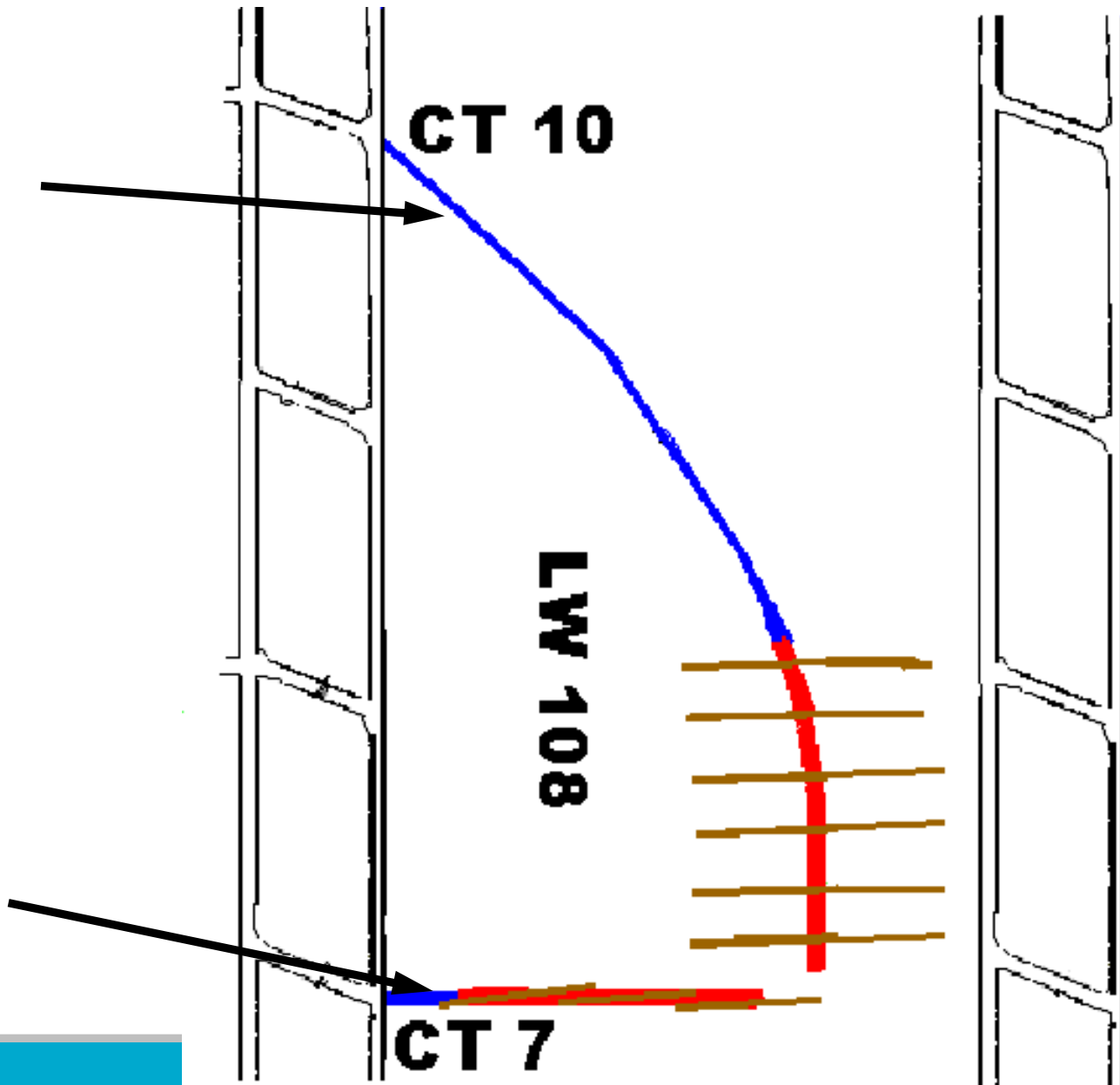
An example from Dartbrook

- The low permeability seam (0.15 md mean perm) was stimulated along two in-seam holes.
- After fracturing, the gas rate from one hole increased by 22 times and from the other by 180 times their respective pre-fractured rates.

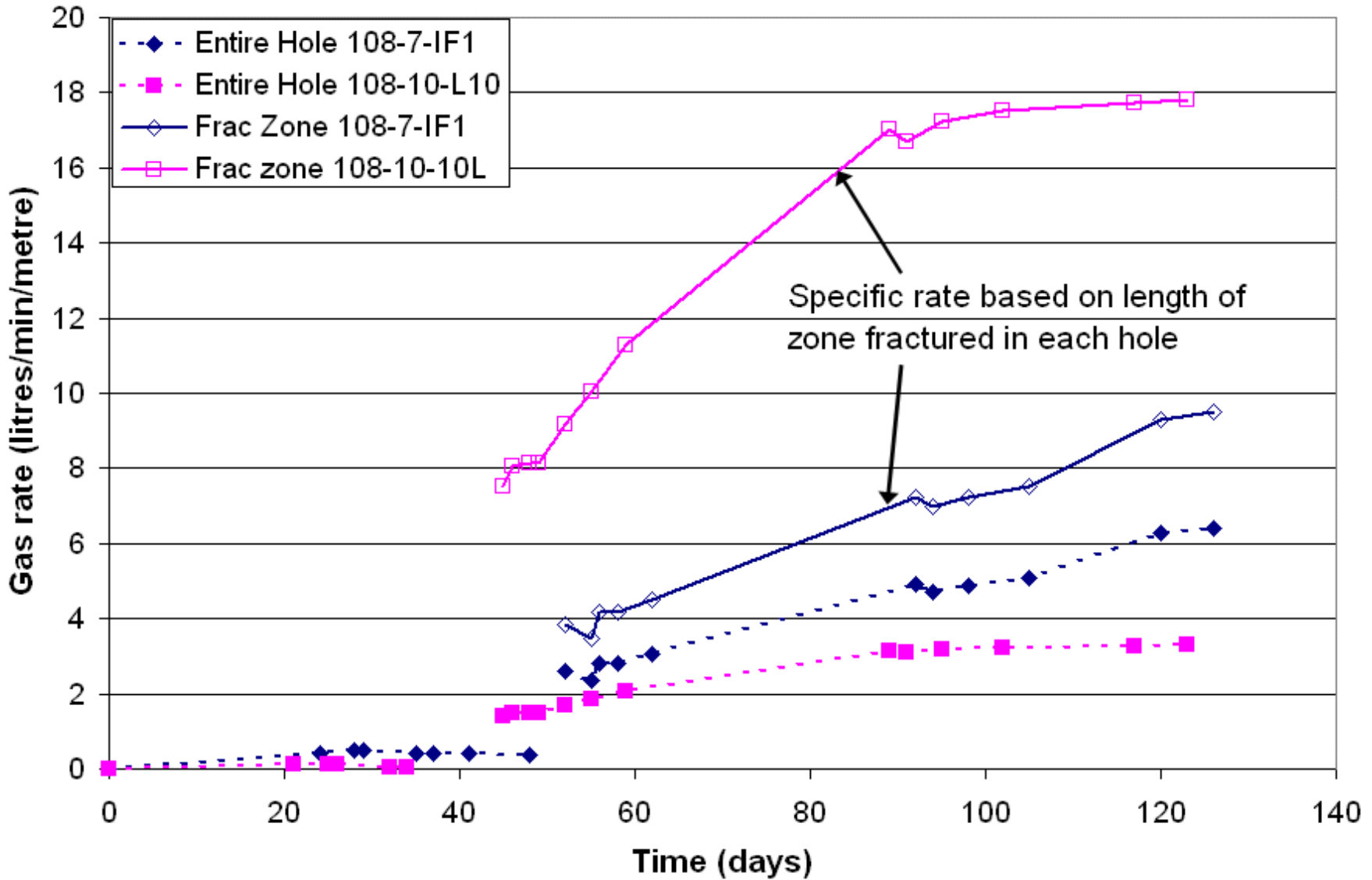
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Dartbrook

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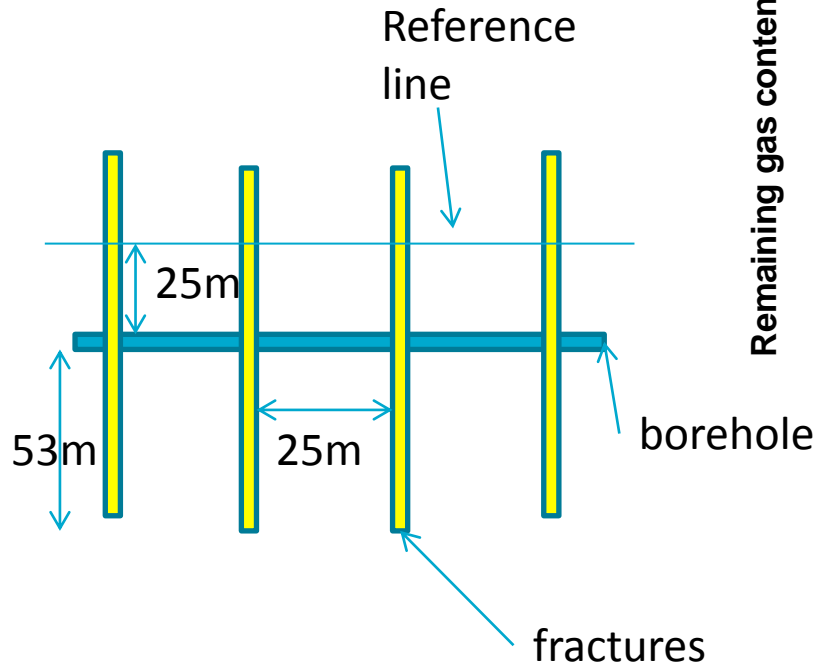


Dartbrook trial results, LW108. 62 m of 336 m hole stimulated.

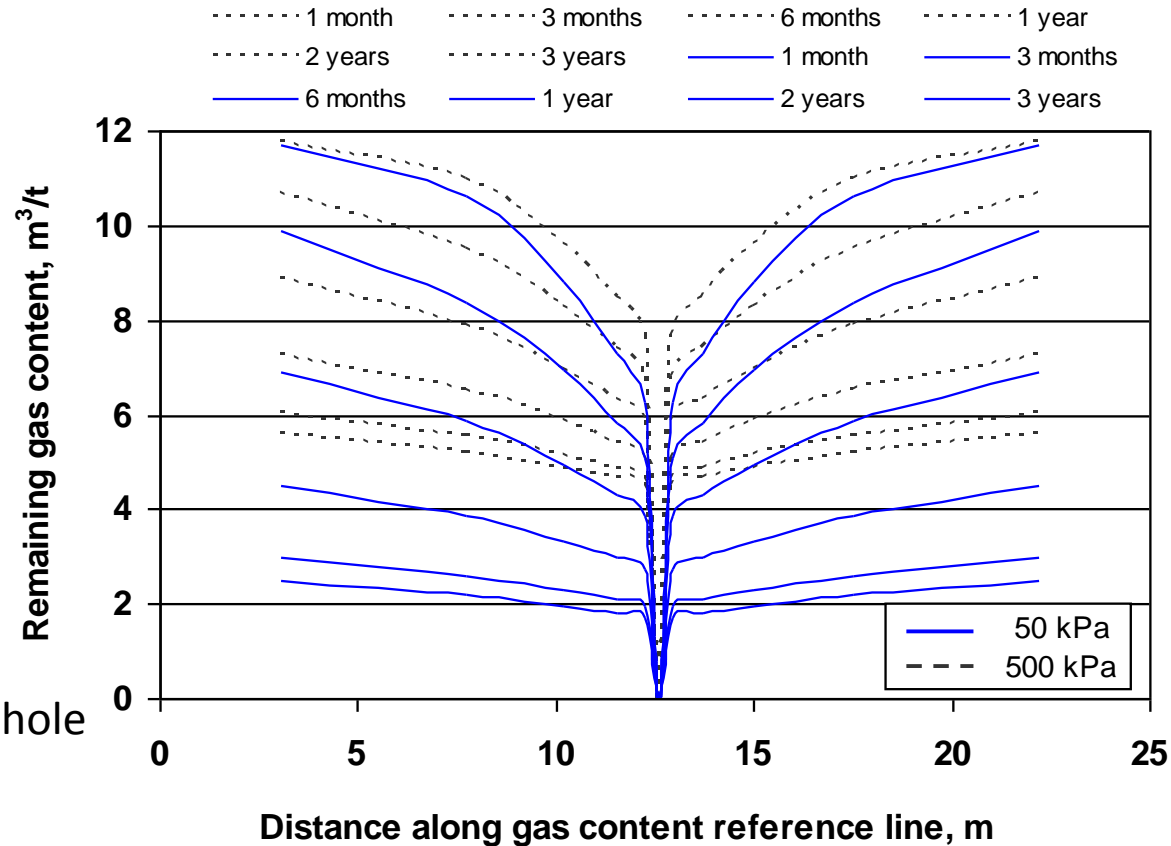


Modelled effect on gas content for a hypothetical site

Modelled gas drainage assuming
25 m spacing between fractures.
Fracture half-length of 53 m
0.1 md coal permeability
For 2 drainage pressures.



For 96% CH₄, 4% CO₂



Process of placing fractures at Dartbrook

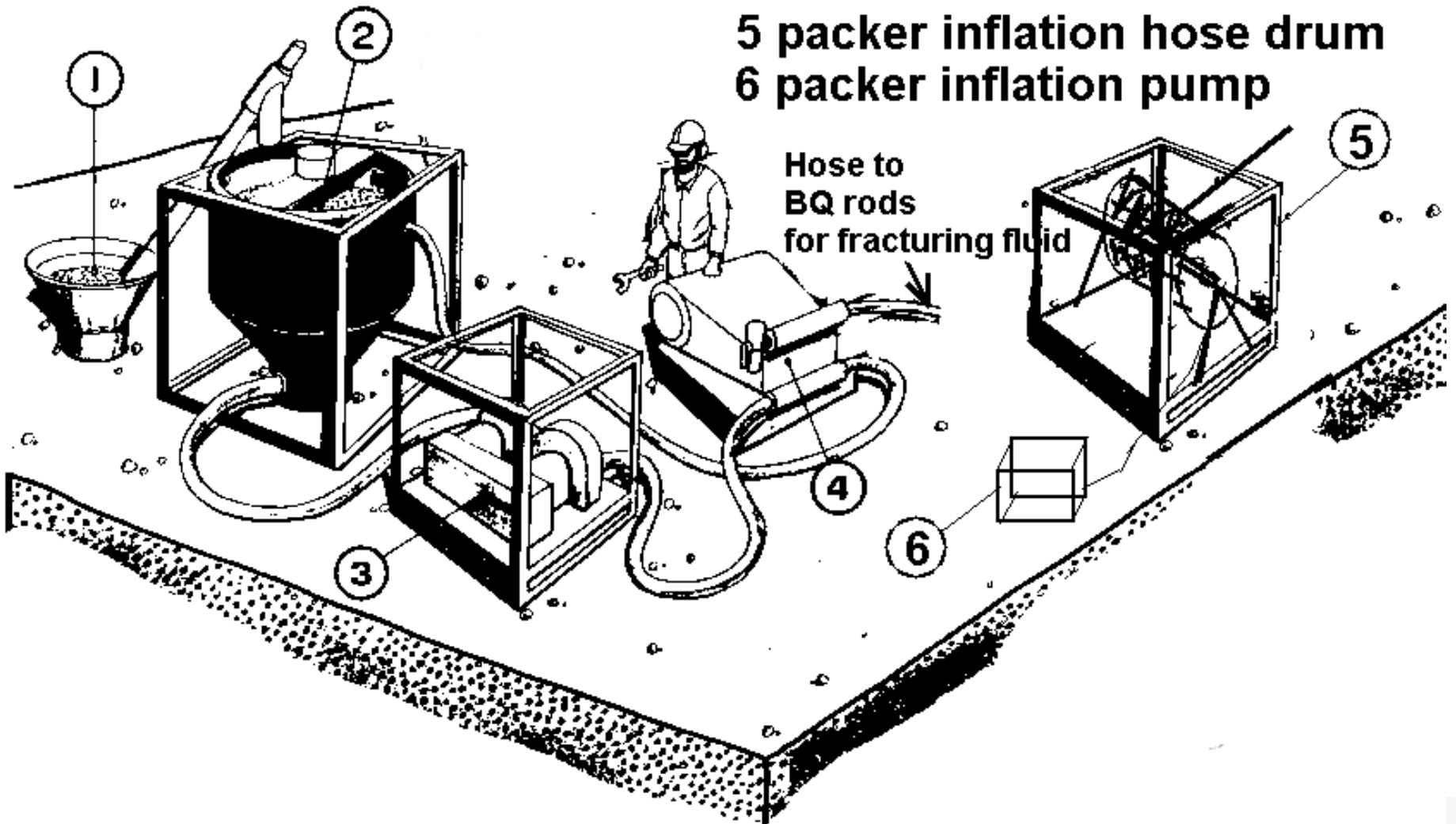
- Straddle packers were run on BQ drill rods with packer inflation string run inside BQ rods
- Fracturing equipment is located underground, mounted on trailer and powered hydraulically
- Pit water and 100 kg of 30/60 mesh frac sand was used per fracture
- A fracture was placed every 3m along hole

Equipment system used to place sand propped fractures at Dartbrook.

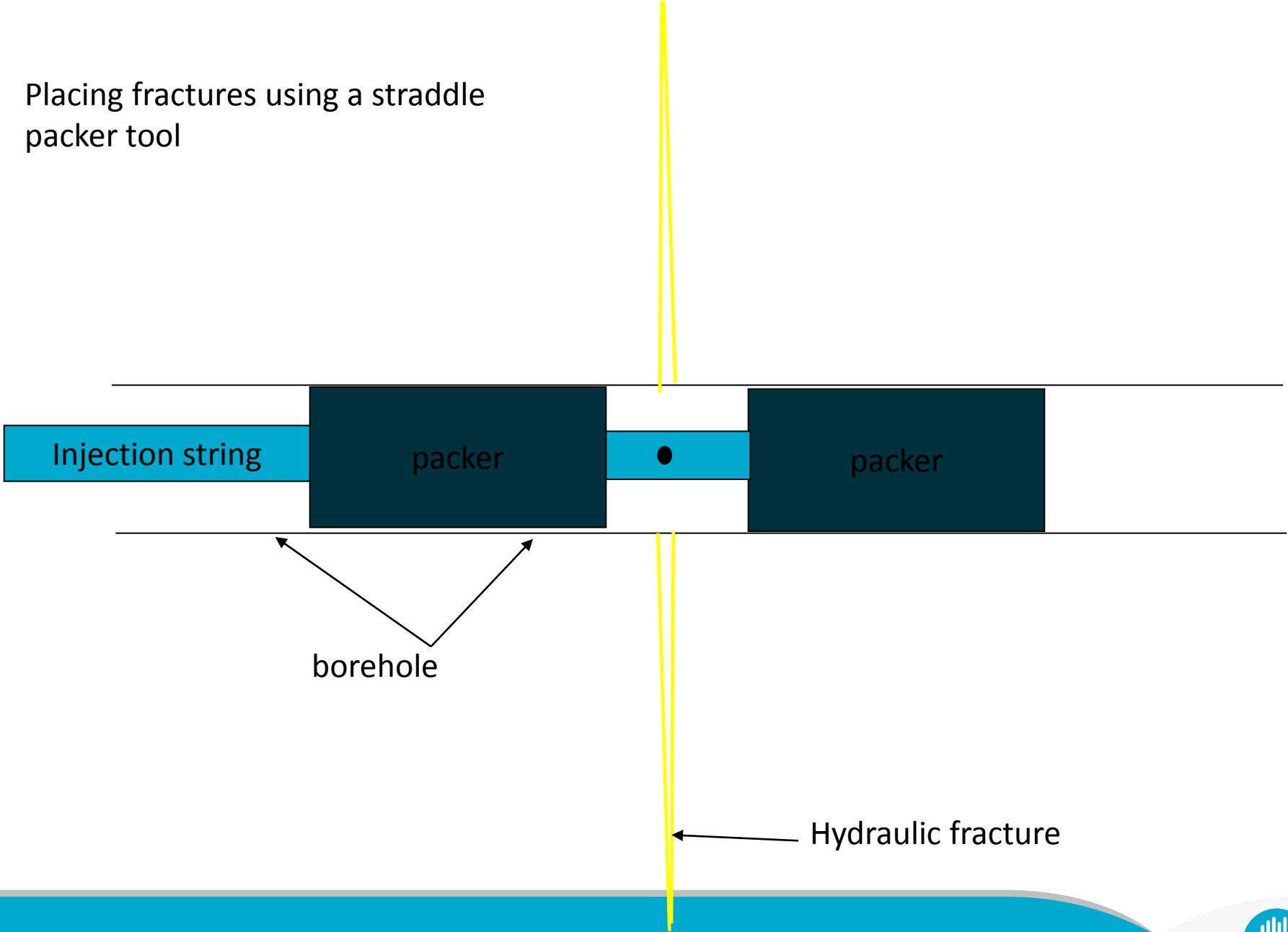
1. Sand auger
2 Blender

3 Centrifugal pump
4 Triplex pump

5 packer inflation hose drum
6 packer inflation pump

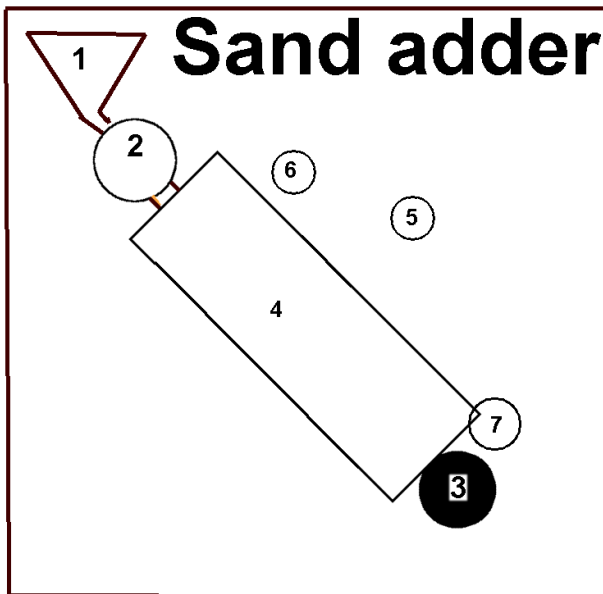


Placing fractures using a straddle packer tool



At West Cliff and United, a sand adder was used with existing longwall salvage pumps to carry out the fracturing.

The sand adder holds 100 kg of saturated sand and delivers it into the high pressure side of the pump. Thus, a longwall water pump can be used to place the sand propped fractures.



- 1- sand hopper
- 2 - fill plug valve
- 3 - empty plug valve
- 4 - sand vessel
- 5 - P release plug valve
- 6 - Pressure in plug valve
- 7 - Flow back plug valve



Sand adder underground

Results and problems

- Stimulation ratios in tests have been more than 10
 - Working in areas that have previously had gas drainage drilling means that some holes are cross connected
 - Locations of nearby existing holes were tabulated and avoided during main stimulation work
 - Junction at branches in holes should be avoided
 - Packer life
 - 10 fracs per packer to start
 - Eventually 50 to 60 fracs per packer by reducing set pressure.
 - Testing in pipe indicates over 200 inflation/deflation cycles per packer can be run without damage, implying borehole condition is factor in shorter packer life.
 - Borehole conditions are likely to require cemented in casing before fracturing for seams below 350 m depth.
 - This was tested at West Cliff and methods were developed
 - Steel casing was required to avoid collapse of casing during fracturing
 - Can steel casing be overcored and removed before mining?

Conclusions

- Sand propped fractures are very effective
- Holes drilled with axis perpendicular to fracture plane perform better
- Better results are possible if no existing drainage holes are present before drilling fracturing holes
- After fracturing, holes should be cleaned of sand and coal debris
- Potential to apply this method to cross measure holes and surface to in-seam CBM wells – but need to develop method to stabilise borehole to allow packers to be used.