

Innovative technologies for operations resulting in:

- ***increased productivity***
- ***reduction in operating costs***
- ***improvements in long term sustainability***



Rock, Paper, Explosives

Ewan Sellers



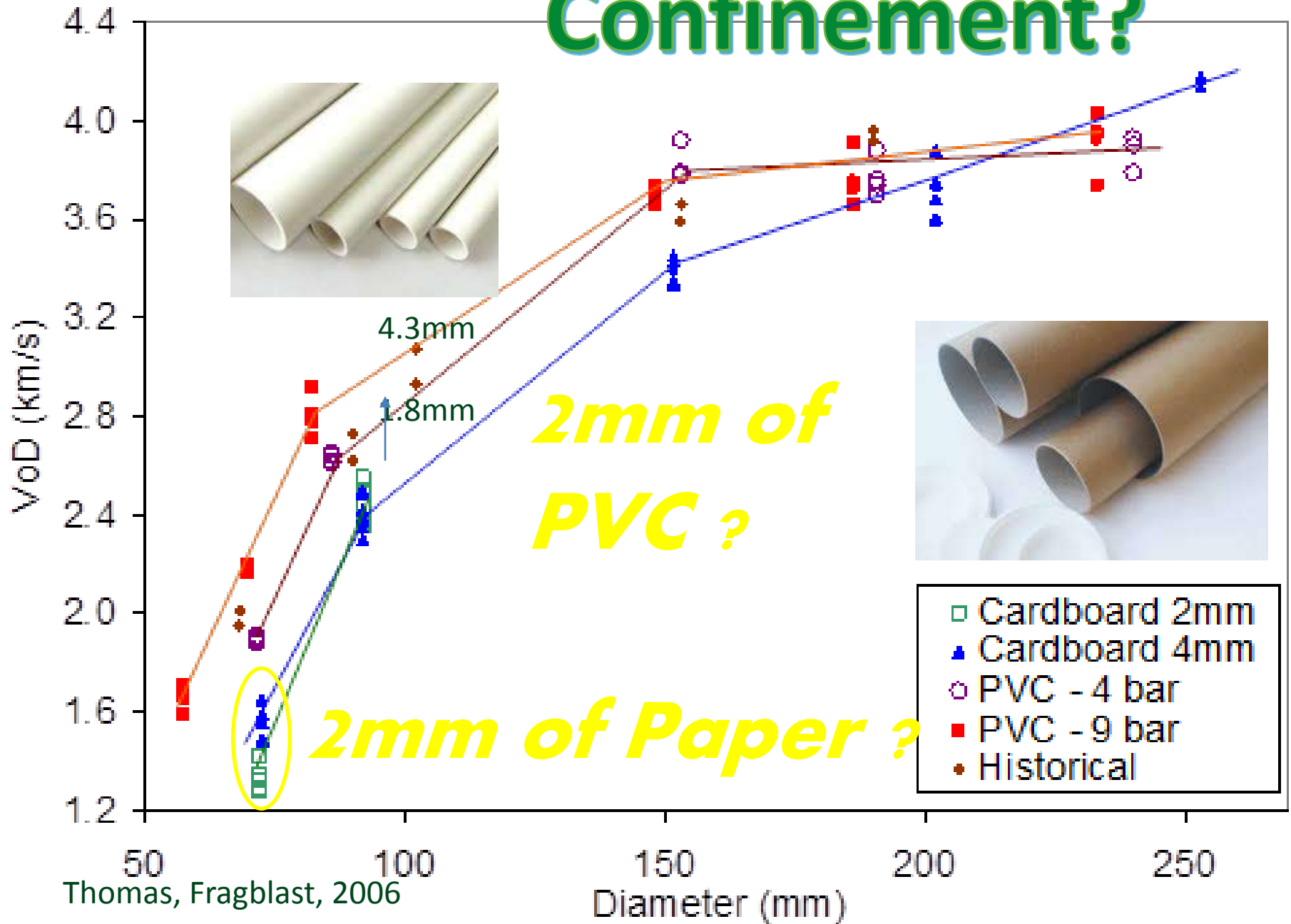
ISEE Australia
7 /11/2016

Confinement?

ROCK



Confinement?



Ultrahigh speed video

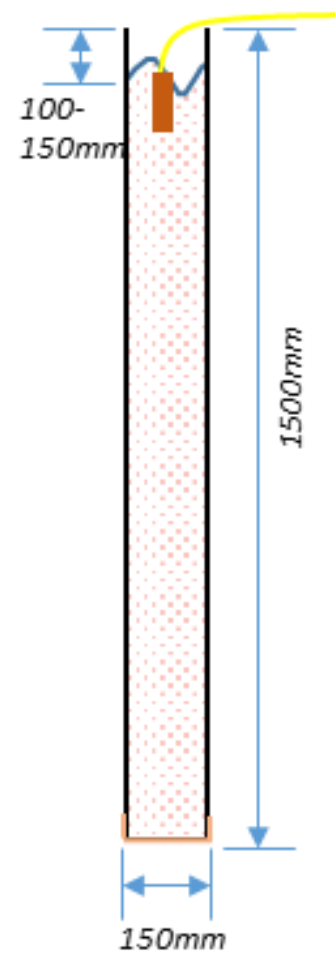
- Usual “high speed” video about 1000frames per second
- Ultrahigh speed from 50 000 – 1 000 000 fps






Sellers et al Fragblast
11, 2015

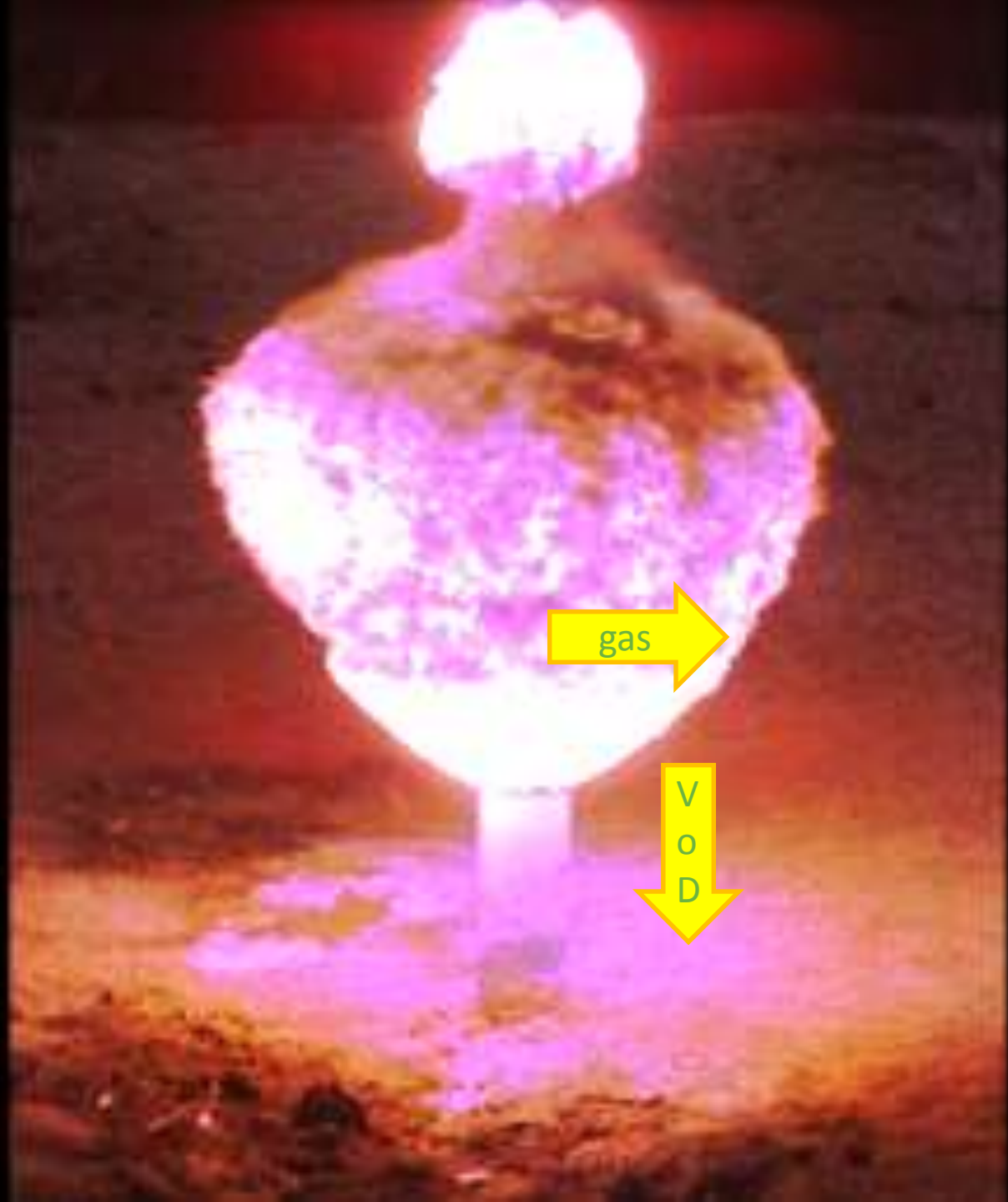
ANFO in
PVC
(not
paper)





A photograph of a lit candle. The candle is positioned vertically, and its flame is bright yellow and orange. A yellow arrow points from the left towards the candle, with the text "Confined by plastic pipe" written inside it. The background is dark, and the candle is set on a dark surface.

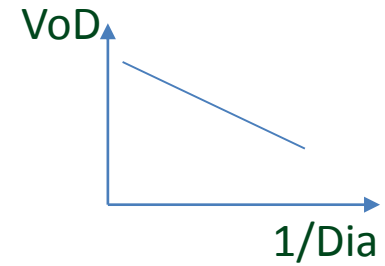
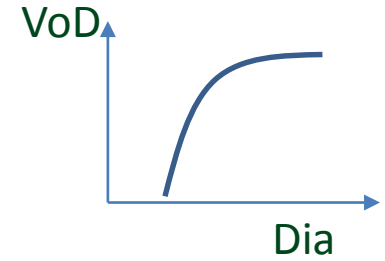
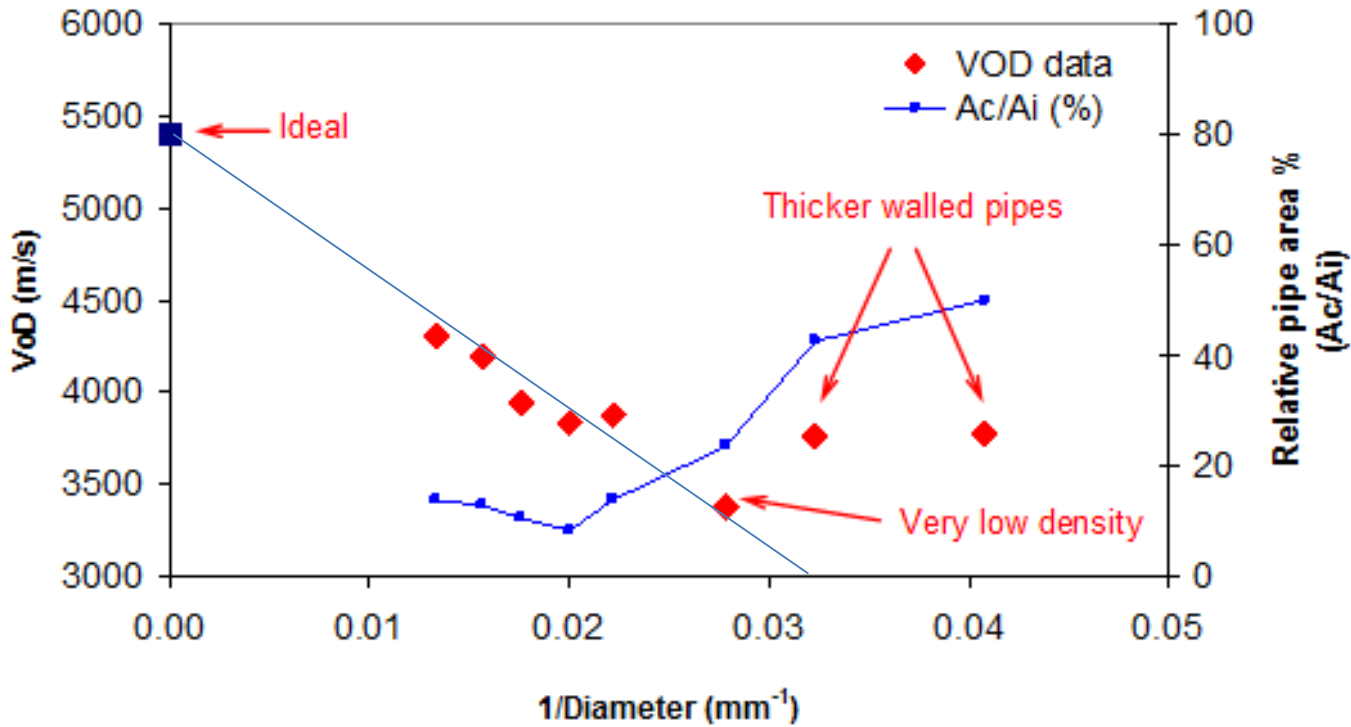
Confined
by plastic pipe



gas

V
o
D

Emulsion?



2mm of Paper ?



No, not confined by
emulsion!

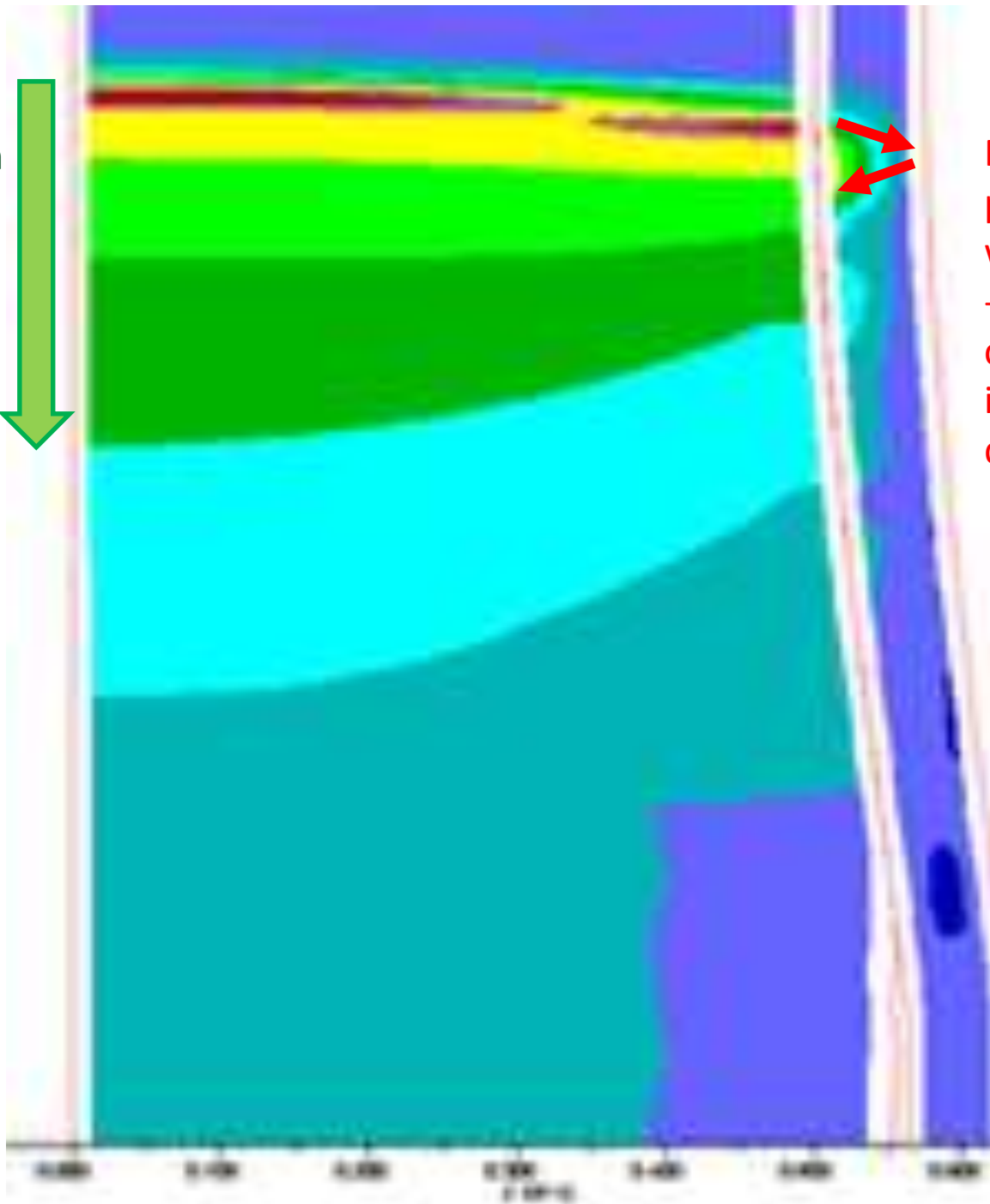
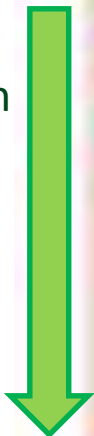




tape

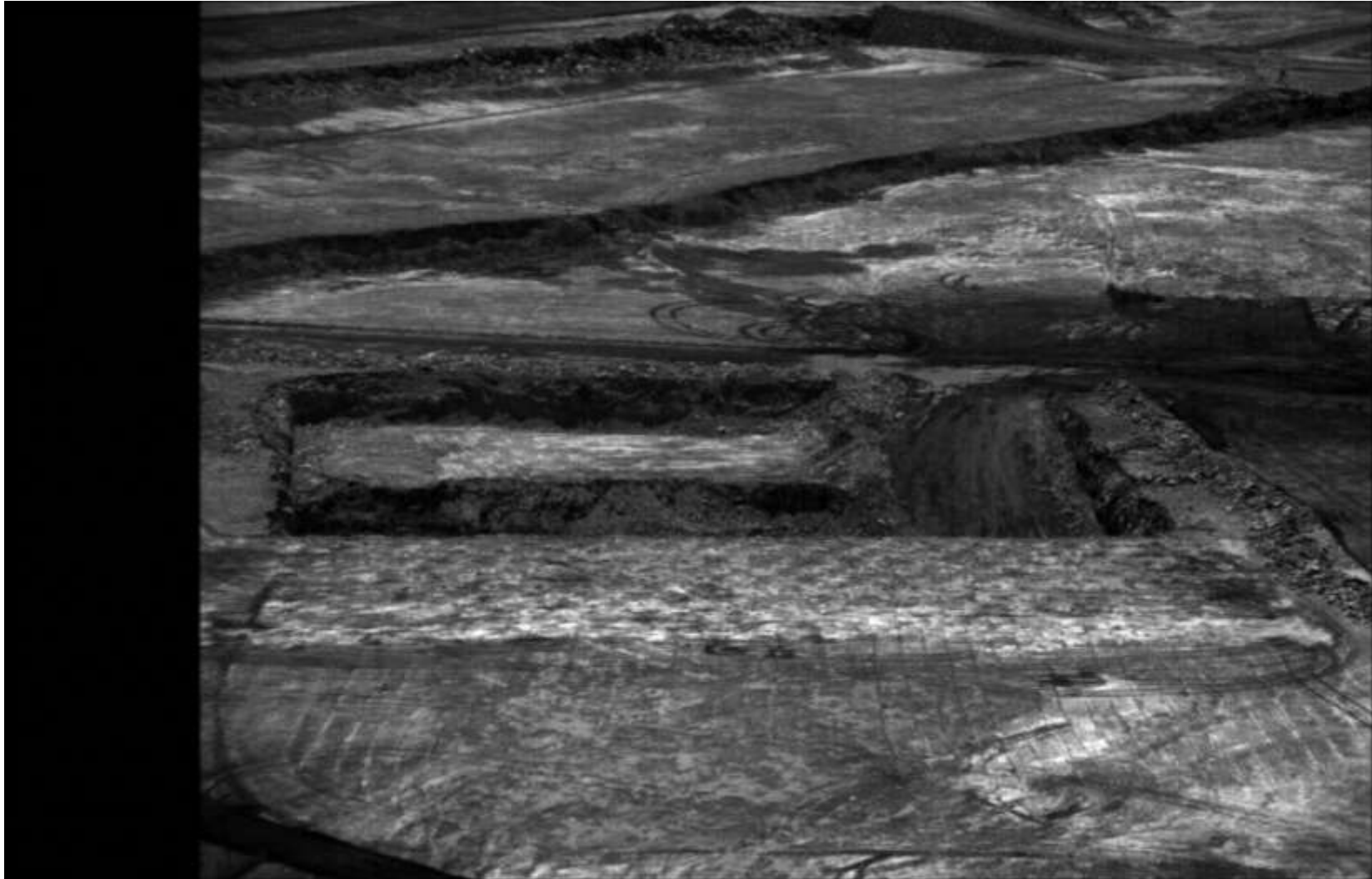


Detonation
Driving
Zone



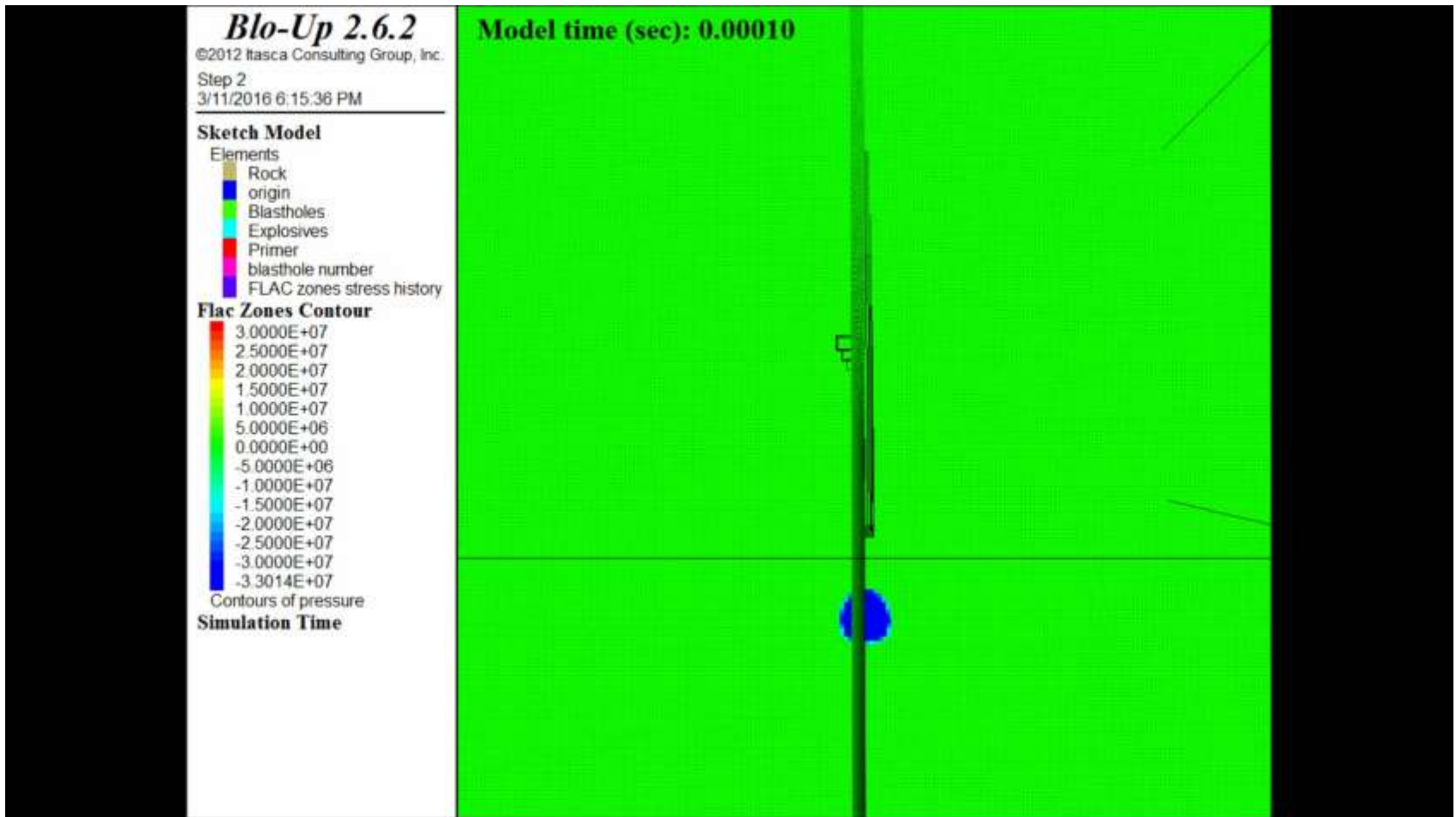
Reflection from
pipe edge
within DDZ
- Thin
confinement
influences the
detonation

Rock?

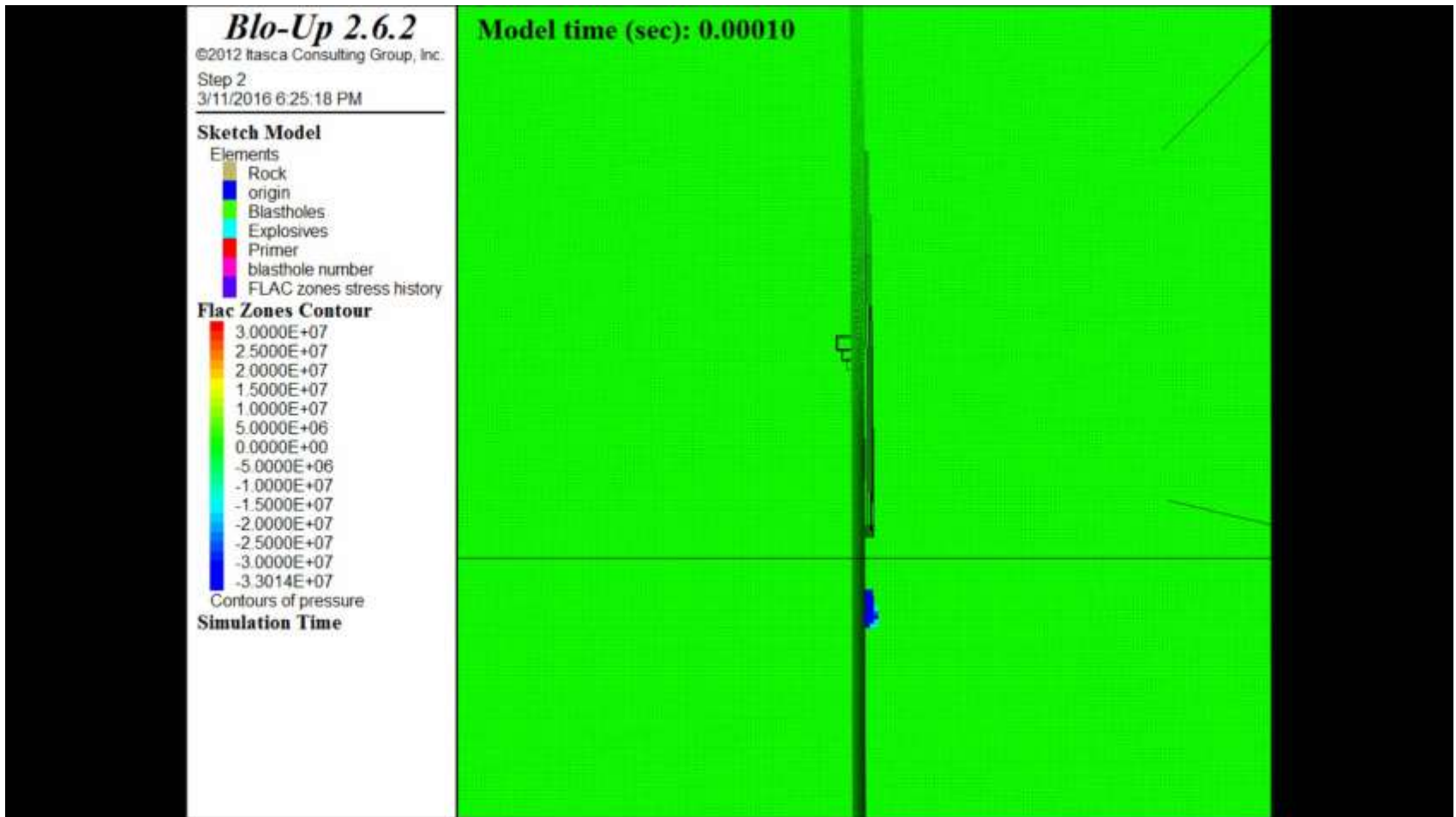


Mauritz Kotze, AEL Mining Services, South Africa

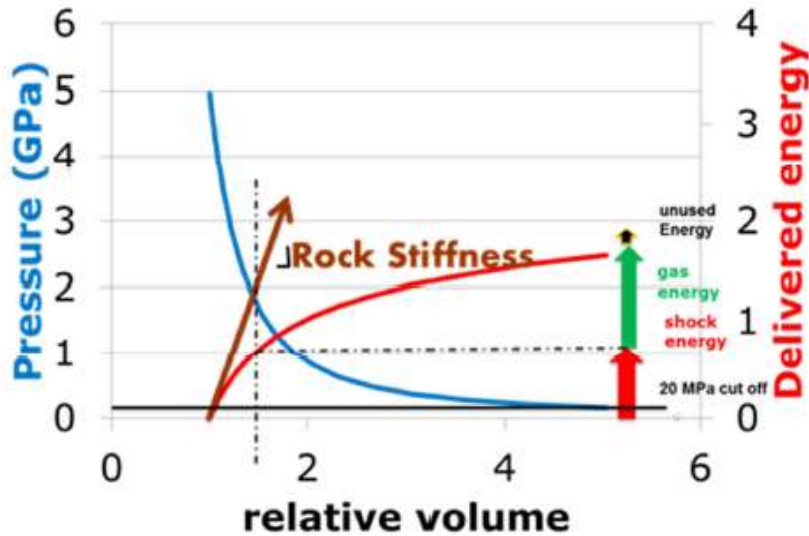
Hard rock



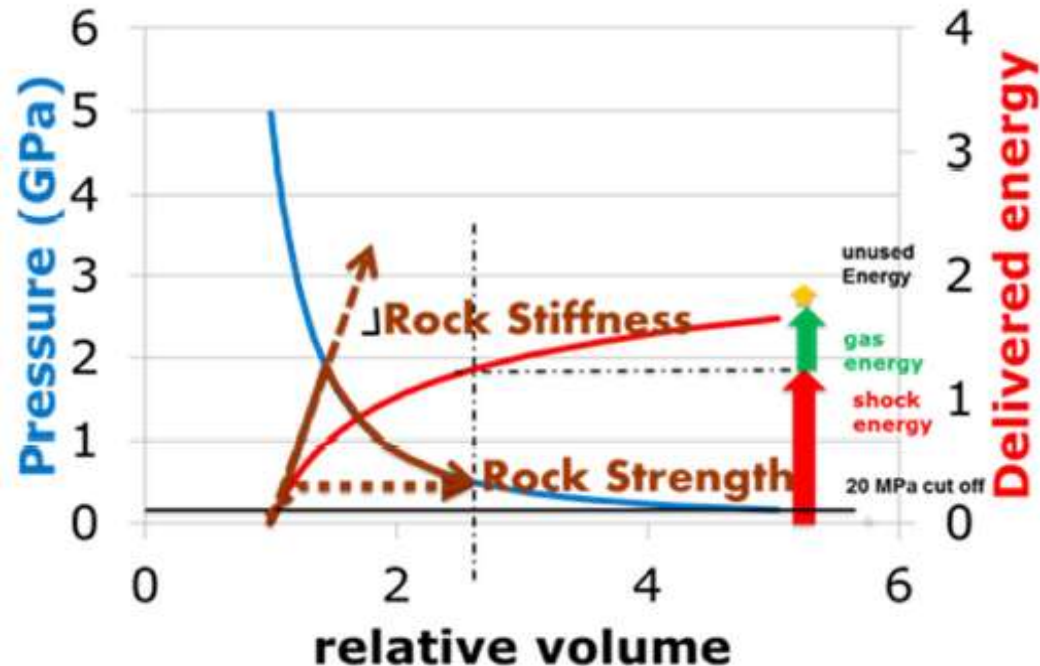
Soft rock



New concept of confinement



Lownds model only takes rock stiffness into account, Need to consider strength too:



Sellers, Fragblast10, 2012
Furtney et al, Fragblast10, ISEE, 2012

Conclusions

- Like the game of rock, paper, scissors the explosive – confinement interaction has many complex interactions and it's not always obvious which “wins”
- Explosive behaviour can be altered by 2mm of cardboard or PVC
- Visualising the interactions:
 - Ultrahigh speed photography highlights new interactions.
 - Computer modelling to see inside the rock and understand the effect of stress and strength
- Leads us towards an updated theory of detonation confinement that considers the real rock behaviour

Acknowledgements

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