

Improved understanding of sublevel blasting

Determination of the extent of the compacted zone, its properties and the effects on caving

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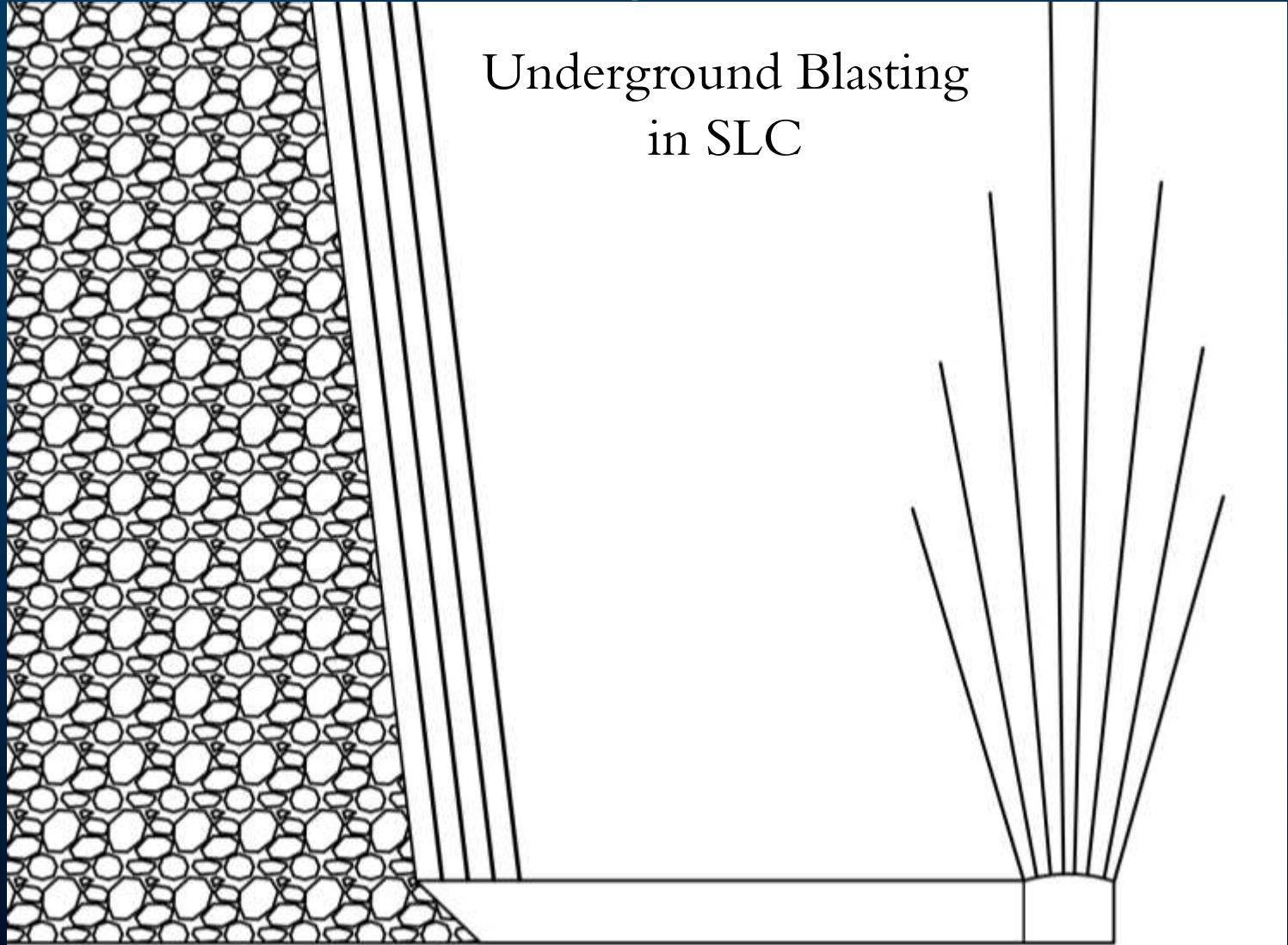


May 16, 2018

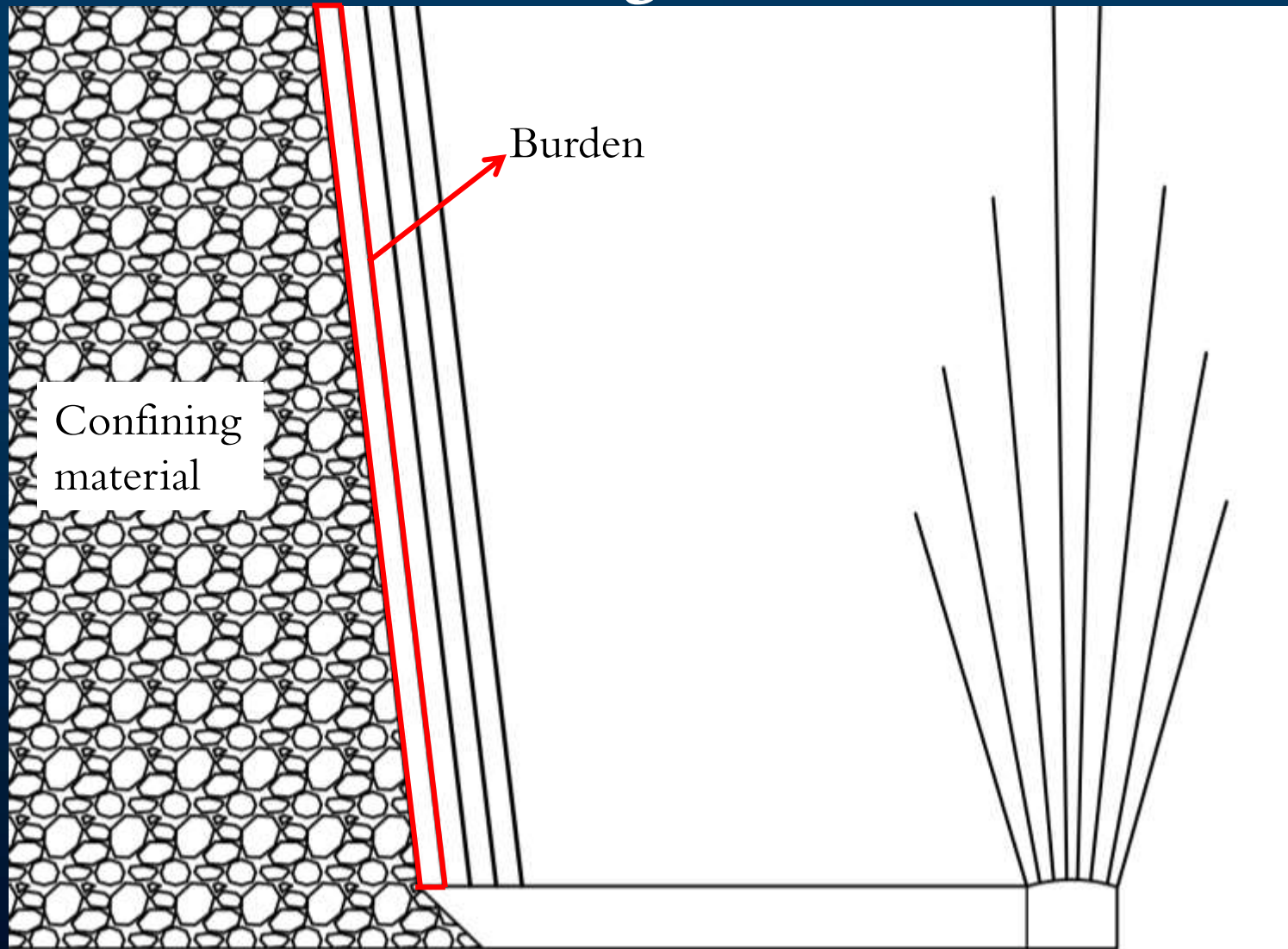


Background

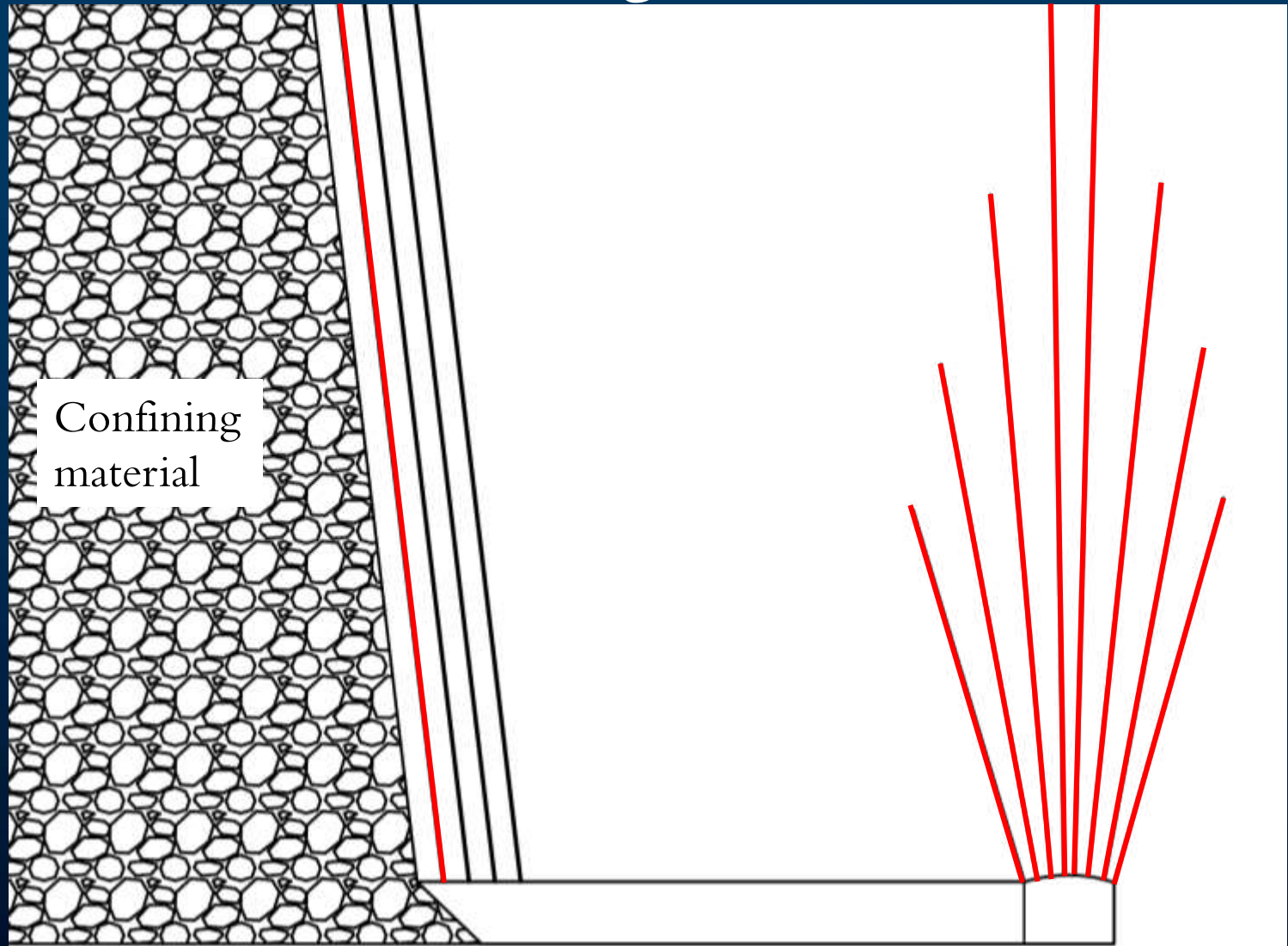
Underground Blasting
in SLC



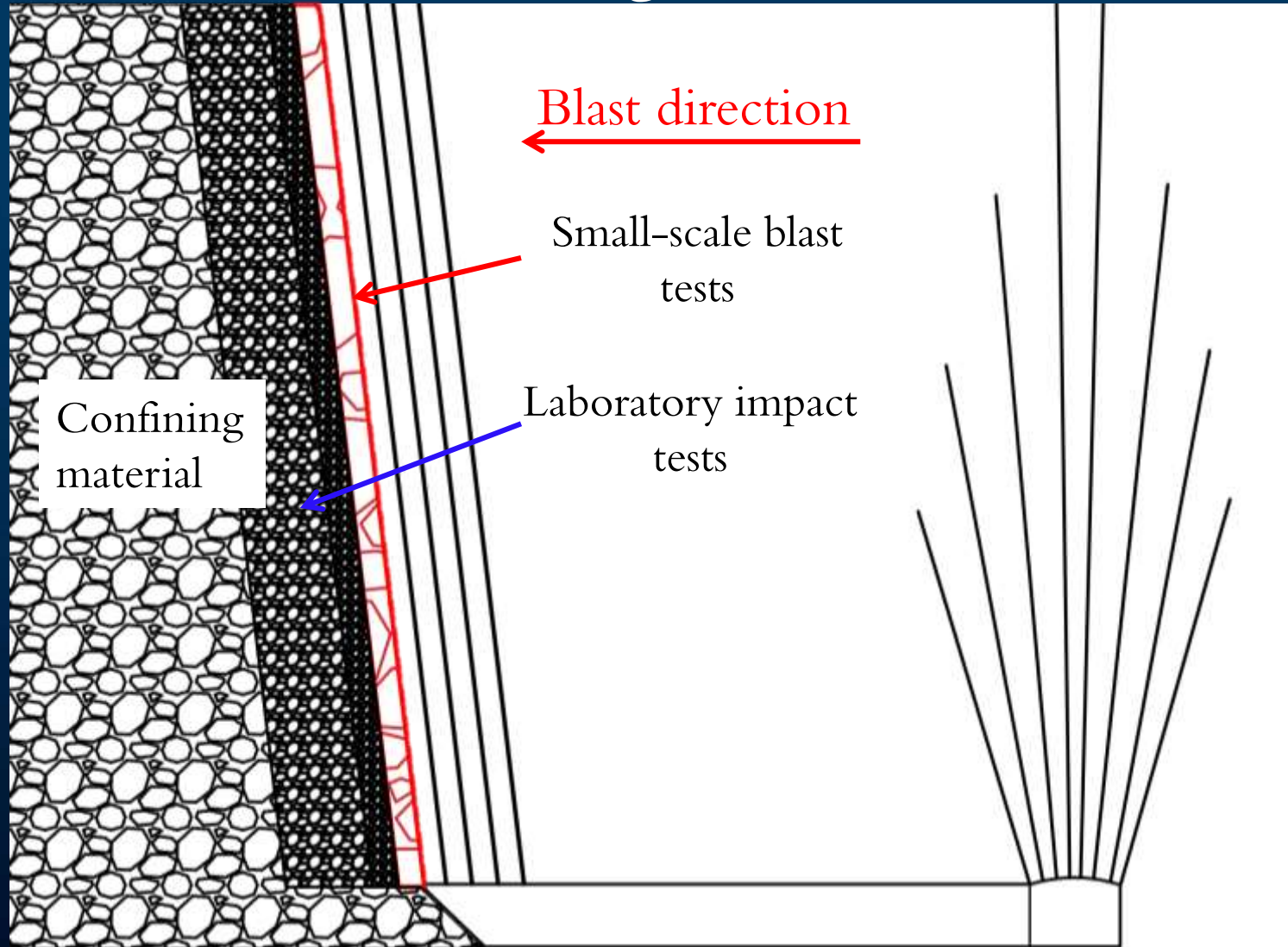
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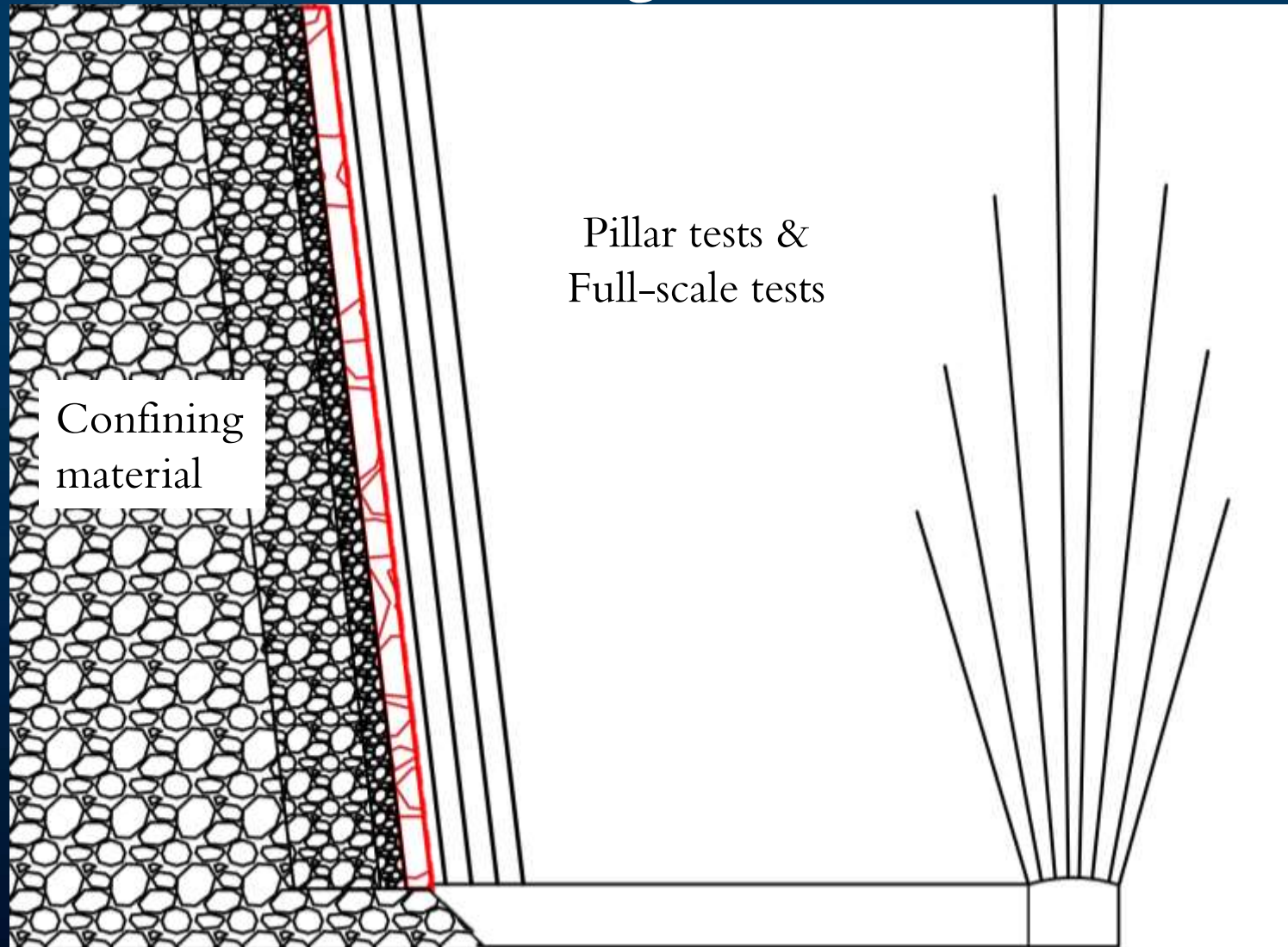
Background



Background



Background





Aims

- To study the interaction between the confining material and the burden
- How the properties of the materials change during blasting

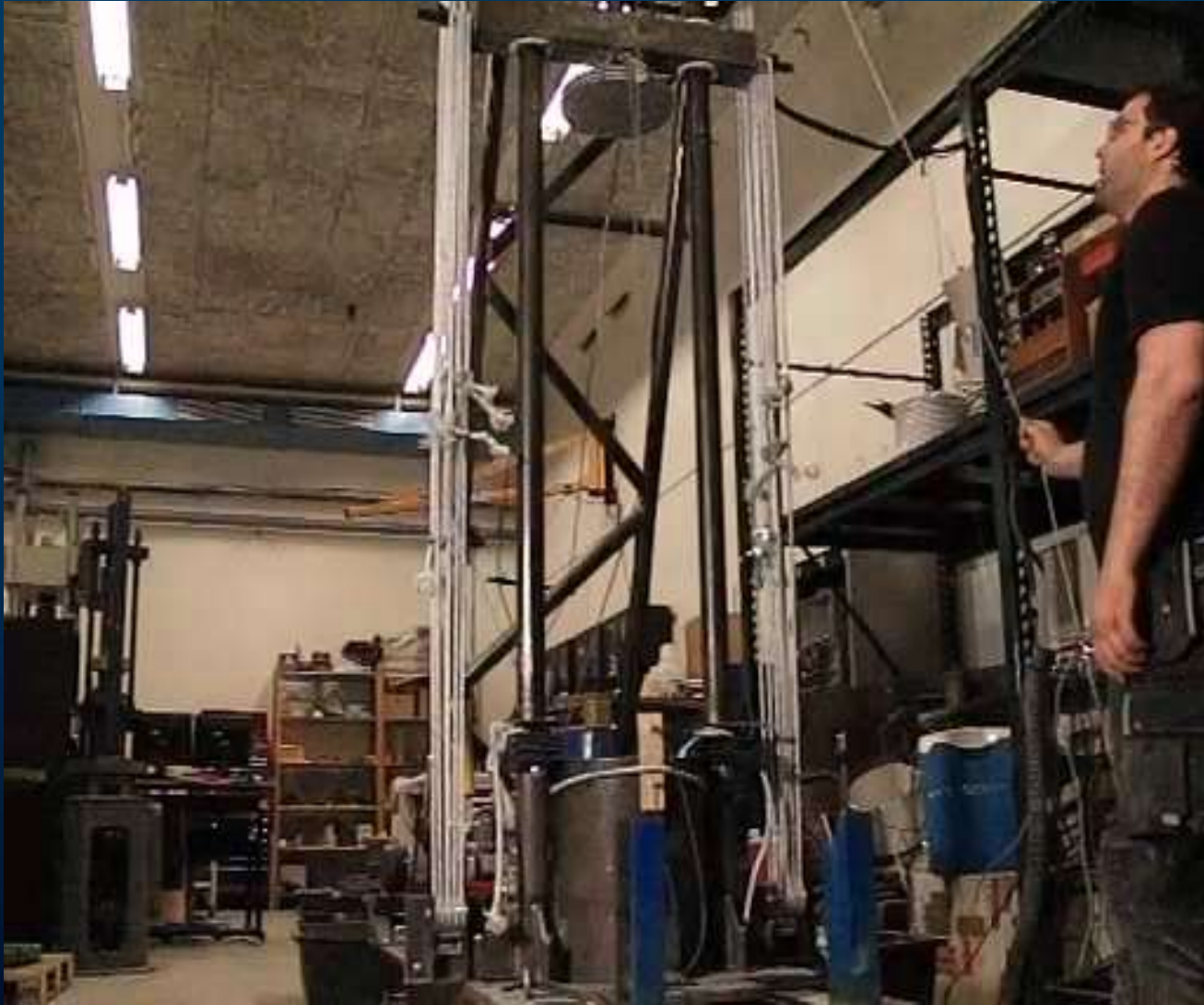
Small-scale blast tests



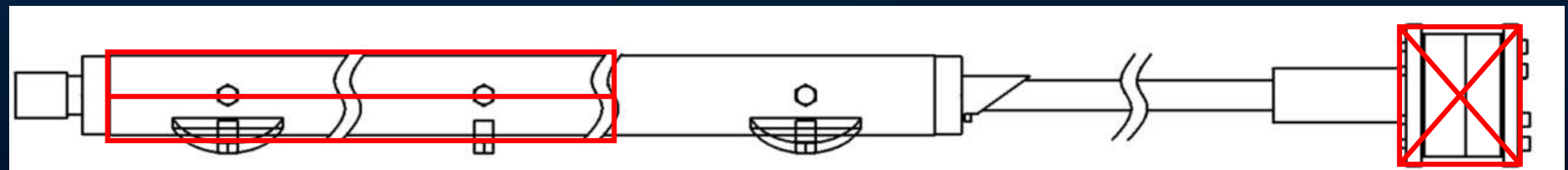
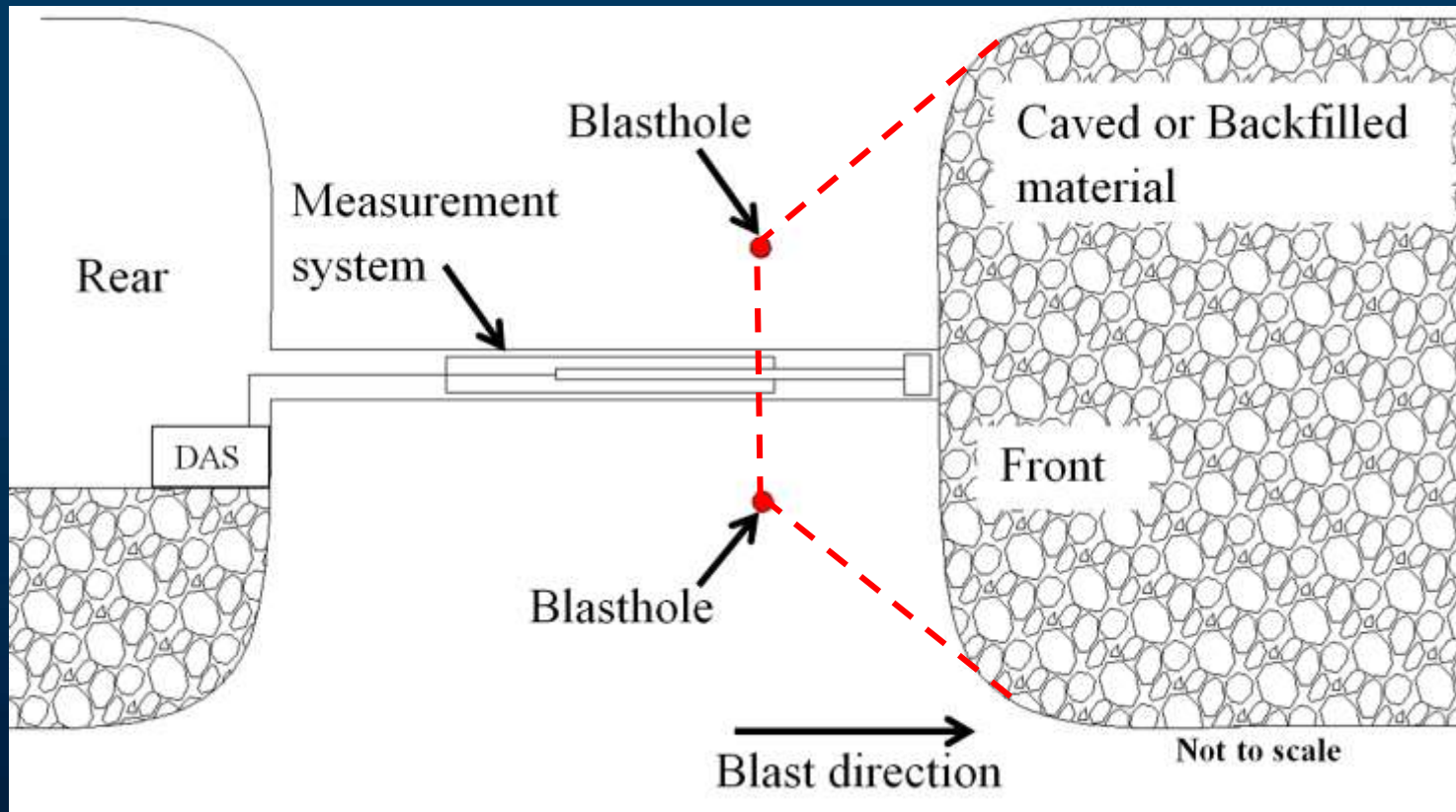
Used Instrumentation:

- Accelerometers
- Draw wire
- Custom-made incremental displacement sensor

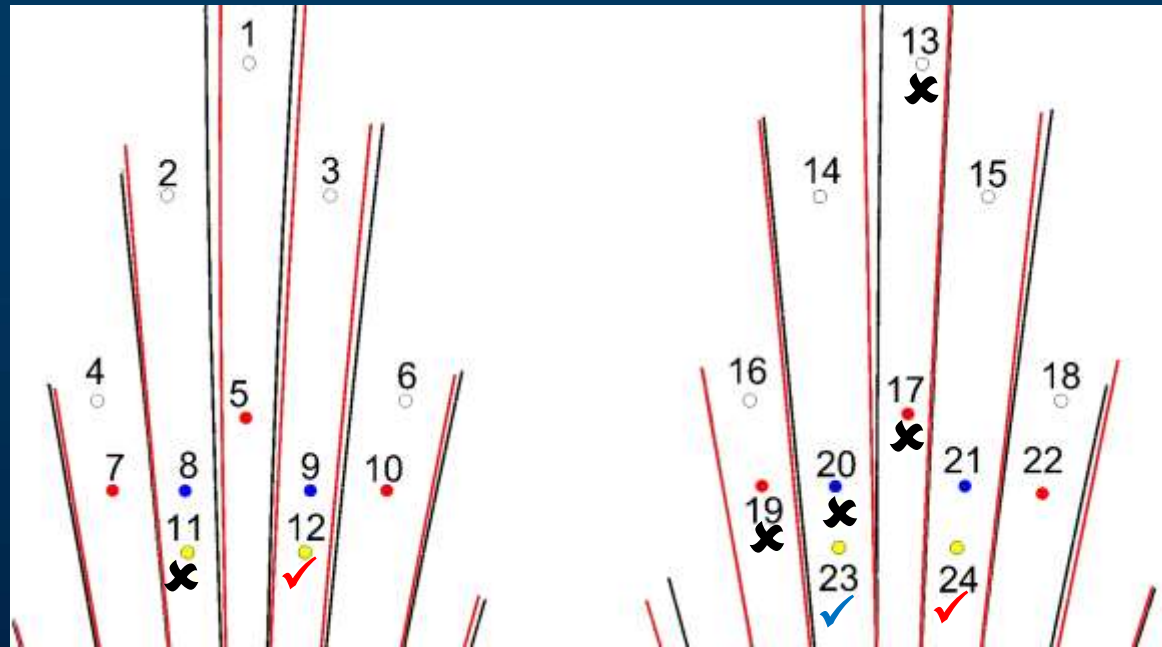
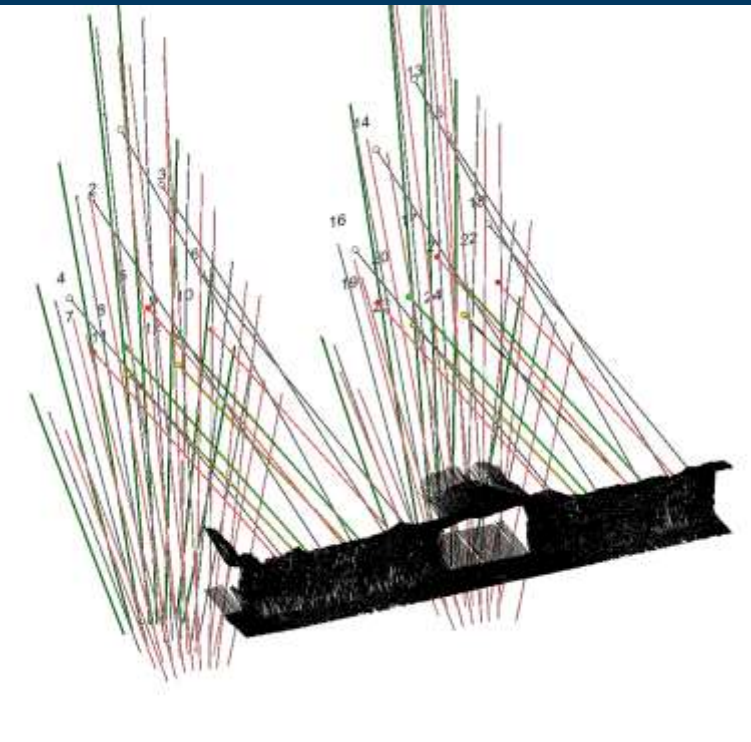
Laboratory impact tests



Pillar tests



Full-scale tests (On-going work)



Level 1022 block 26

- TDR cables
- Live systems (accelerometers)
- Draw wire
- Inspection/back up holes



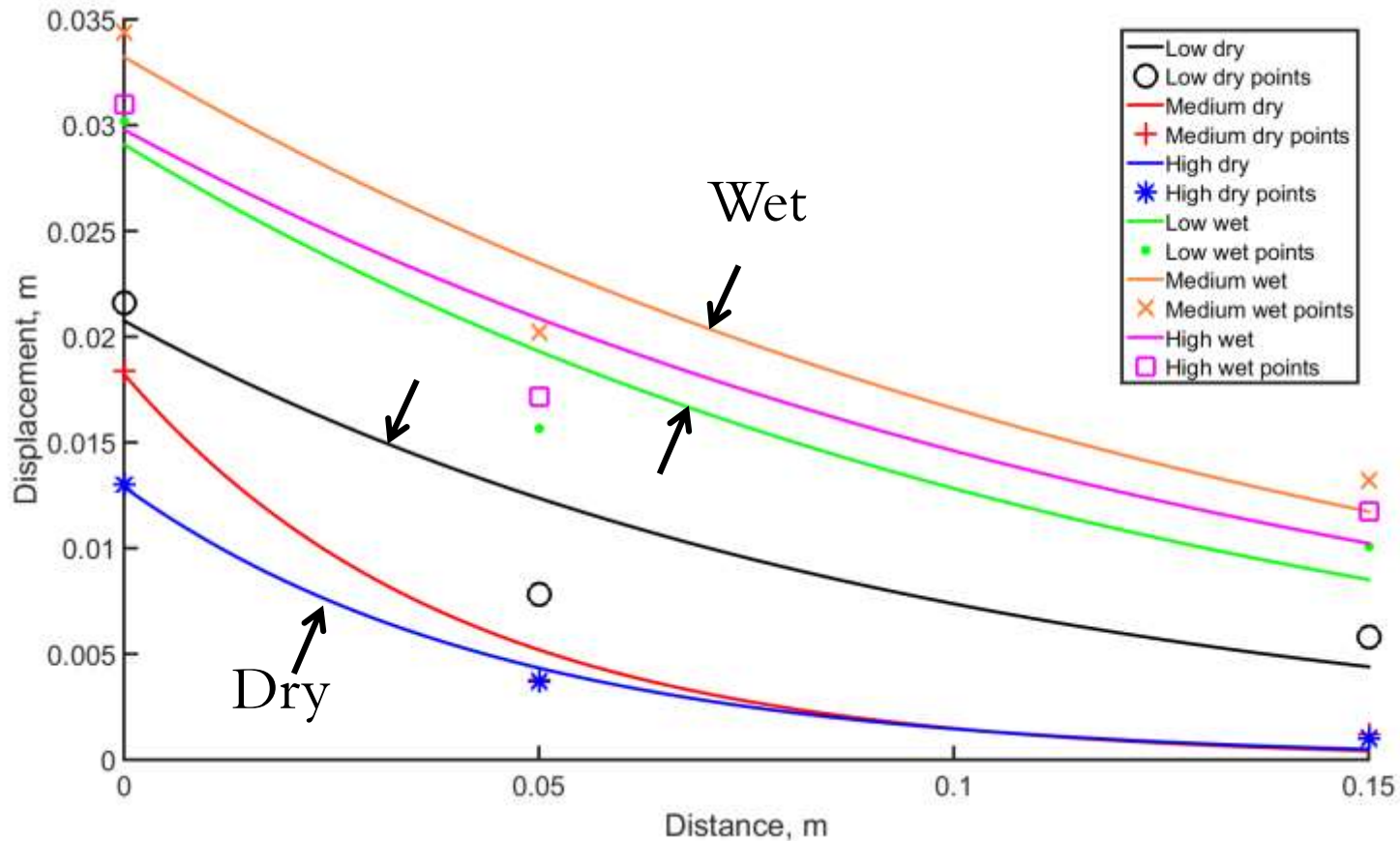
Results

The results are based on:

- 8 small scale blast tests
- 43 impact tests
- 2 pillar tests
- 2 full-scale tests (yet to be analyzed, blasted 9th of May)

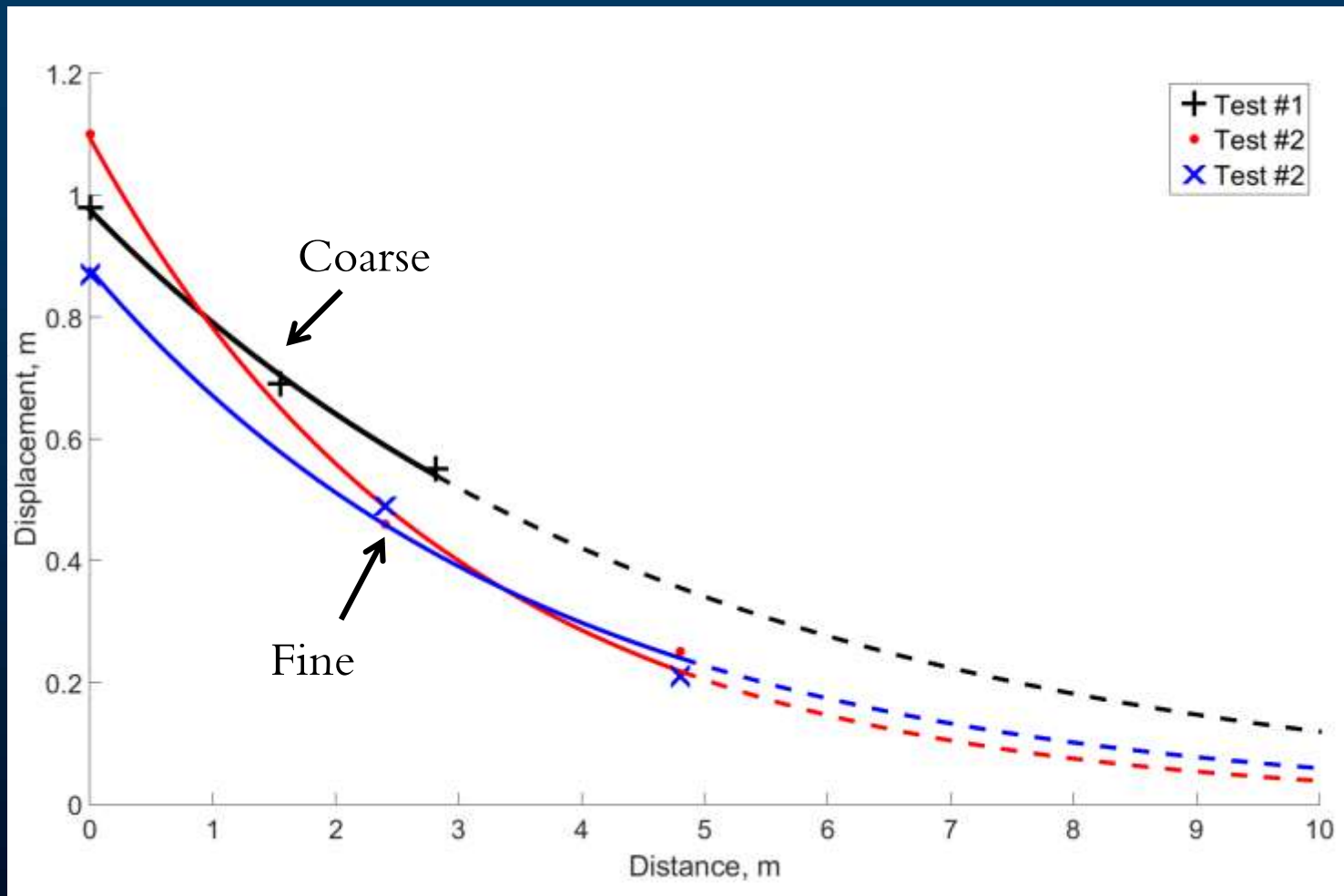
Results-Impact tests

$$\text{Displacement} = e^{a+b \cdot \text{distance from burden}}$$

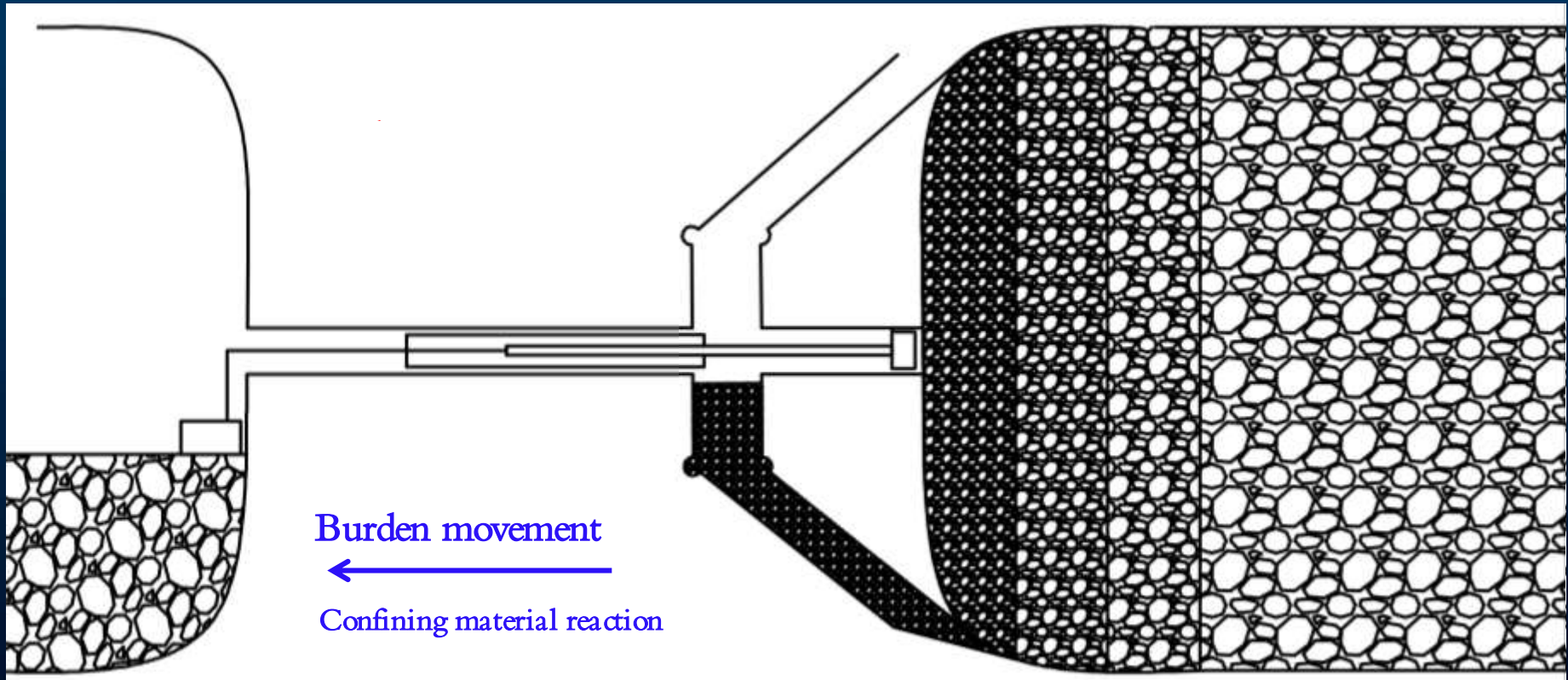
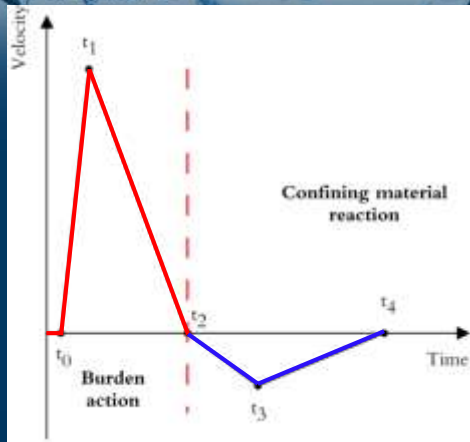


Results – Pillar tests

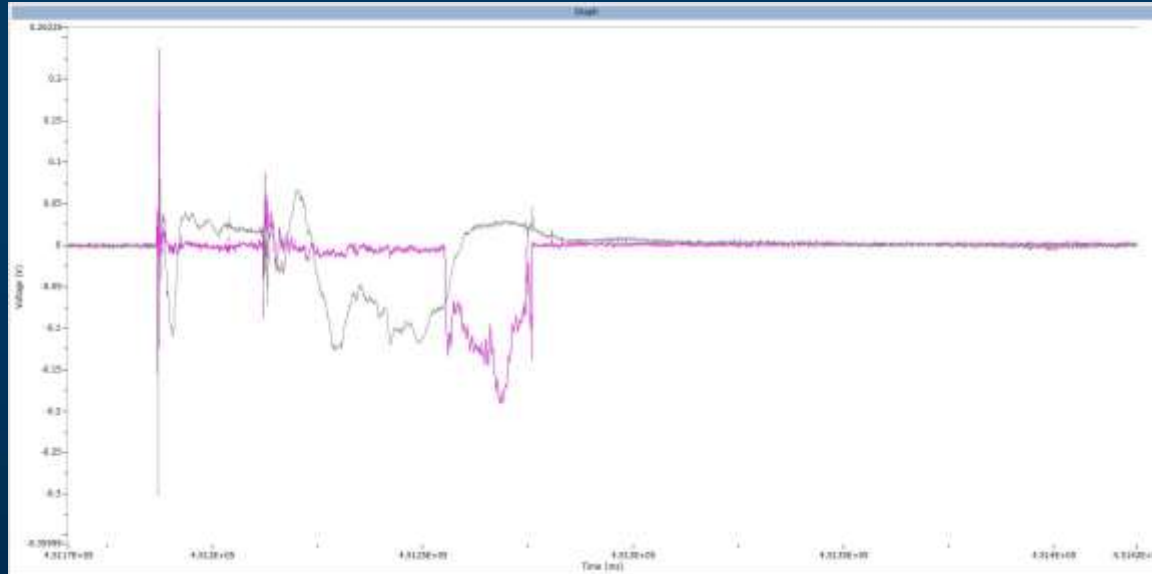
Displacement = $e^{a+b \cdot \text{distance from burden}}$



Results – Small scale blast & Pillar tests



Results – Full-scale tests (preliminary results)



Pulling velocity
 ≈ 80 m/s
True time 55 ms



Conclusions

Confining material behavior

- Particle-to-particle interactions
- Elasto-plastic behavior of the particles without breakage
- Over-compaction when water and fine particles are present
 - Tensile strength is introduced
- An inverse exponential function can describe the extent of the compaction zone

Burden behavior

- Limited movement
- Burden seems intact even if the fracture network was developed
- Backward burden movement due to relaxation forces from the confining material
- Burden erosion material appears in the gap between the blasted and intact rock

Acknowledgements

Supervisors: Assoc. Prof. Daniel Johansson &
Prof. Erling Nordlund

Financial Support





Thank you very much!