Ore Pass Stability Analysis at the Brunswick Mine Using PFC3D

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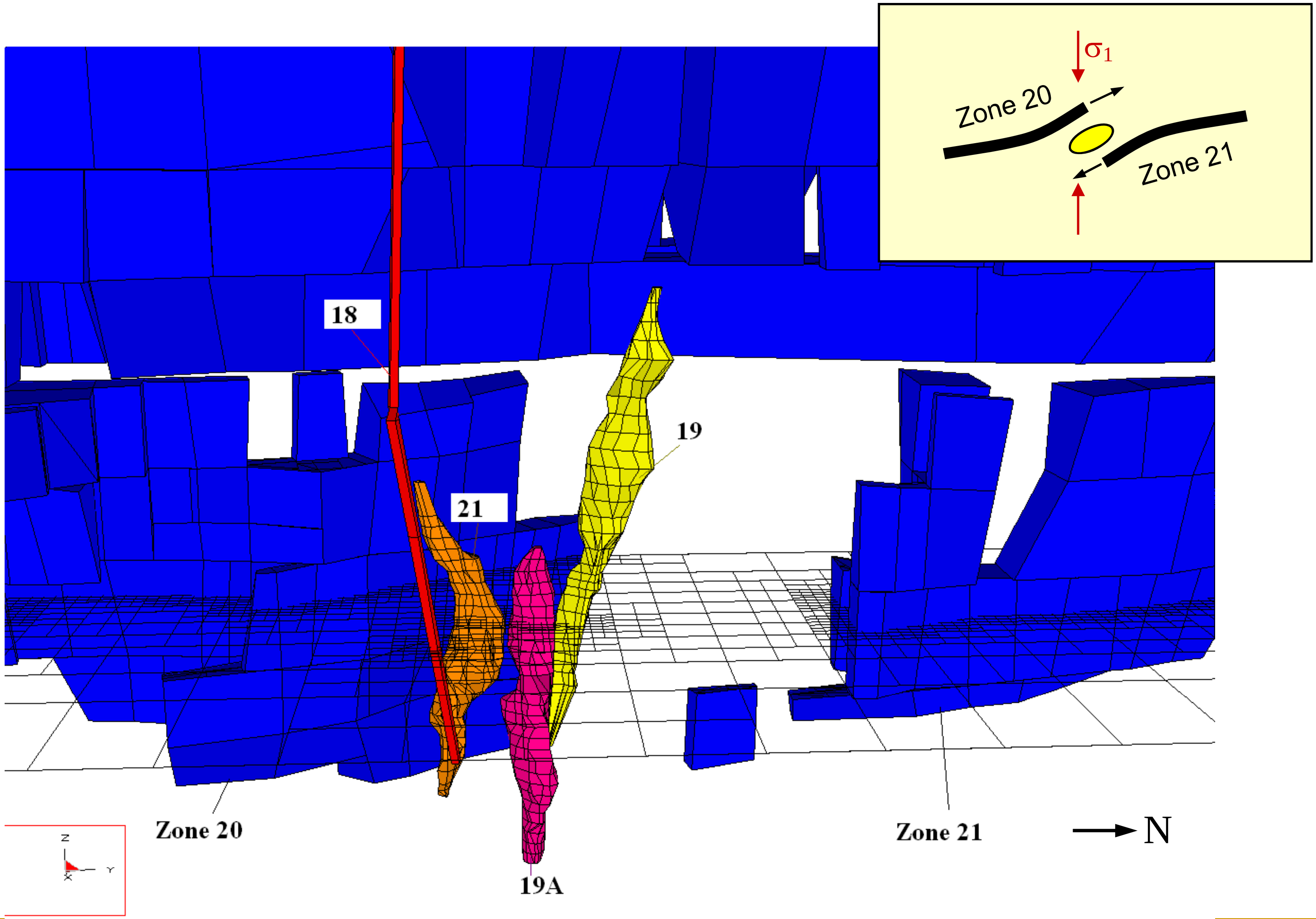
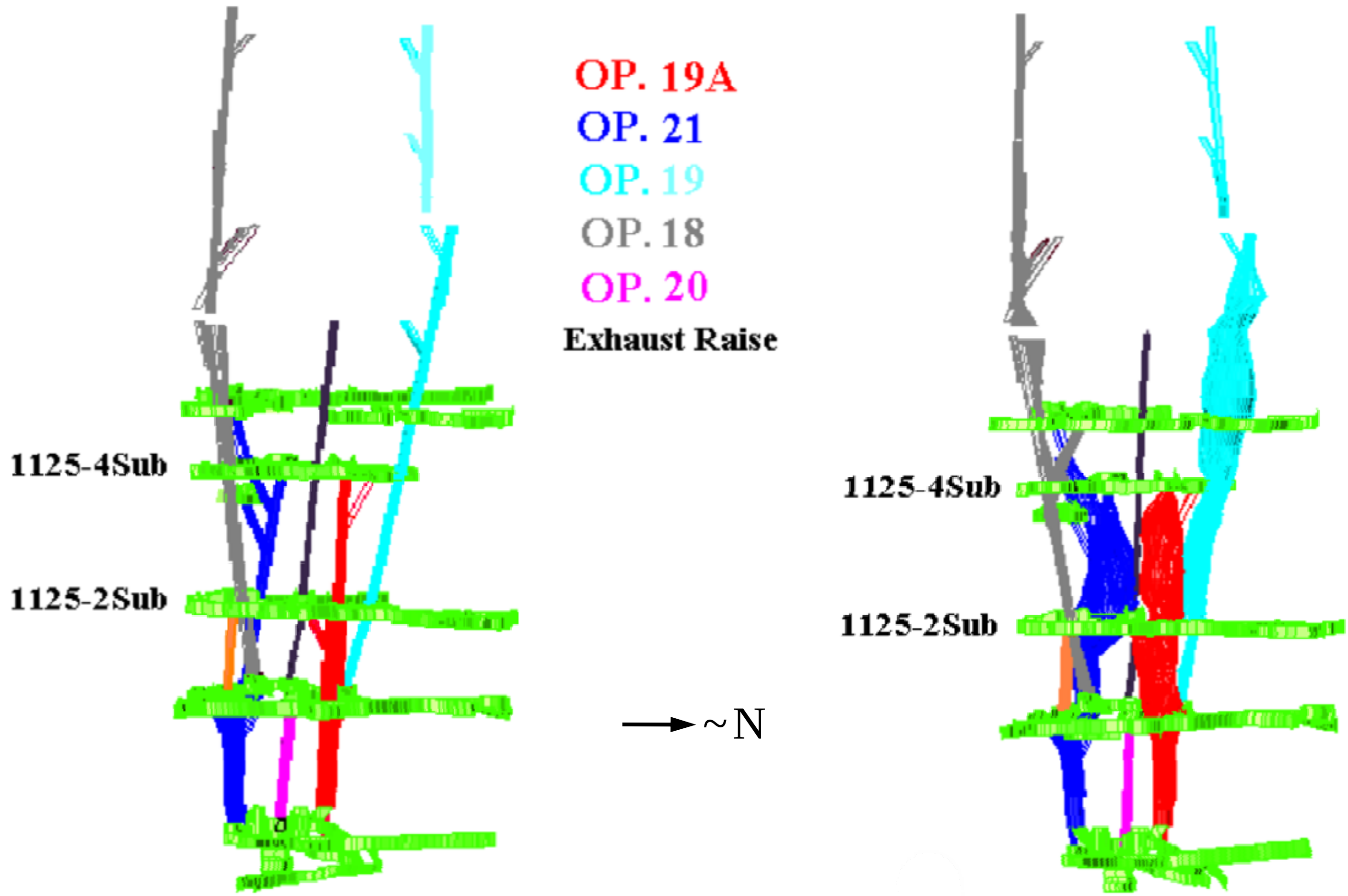
Introduction and background

- This presentation reports on numerical investigations with PFC3D aimed at improving our understanding of the combined influence of stress and structure on the integrity of ore passes in an operating mine
- This has significant implications on understanding some of the complex mechanisms that control the structural integrity of ore pass systems
- The particular case study discussed is that of the 18-21 ore pass complex at Brunswick Mine

Ore pass systems at Brunswick Mine



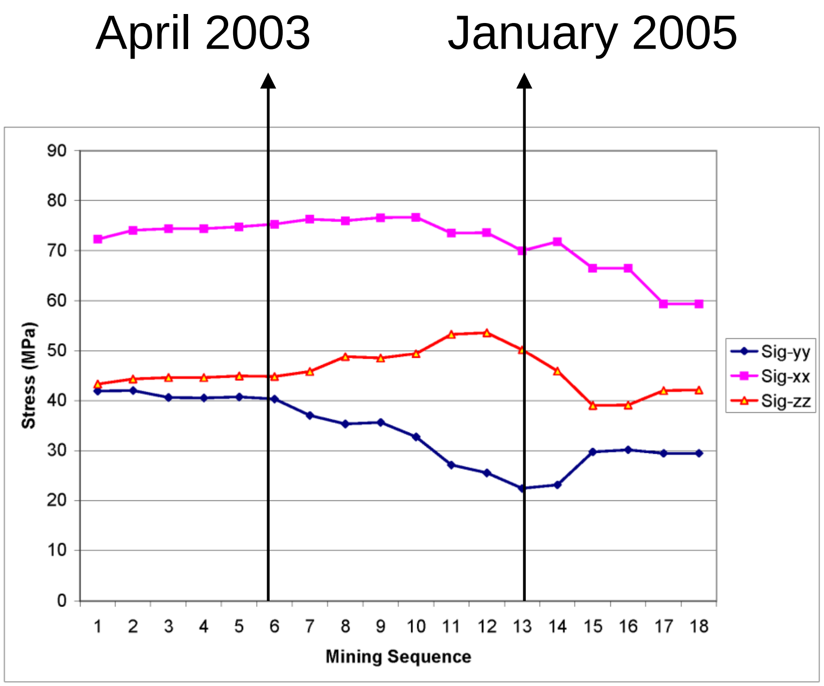
Ore pass systems at Brunswick Mine



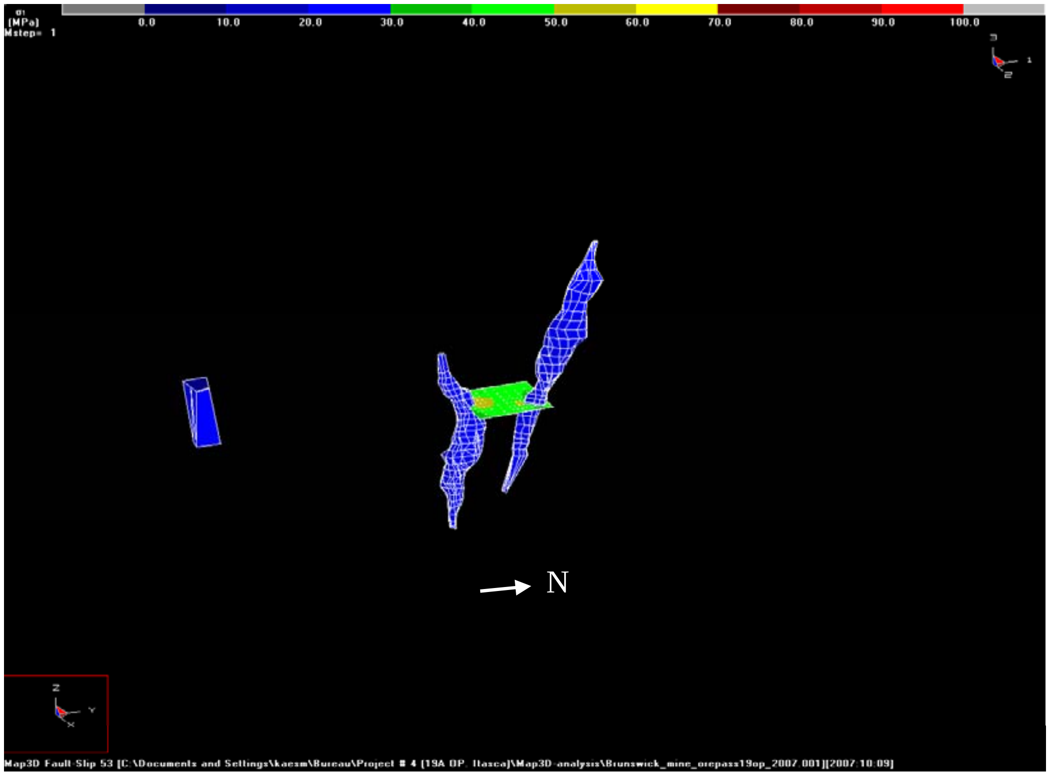
Original dimensions

Present dimensions (based on CMS campaigns)

Global modelling (stress)

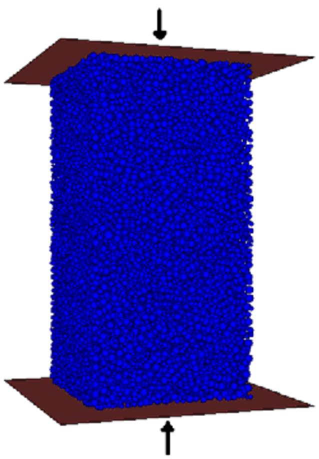


Global Modelling was done at two mining steps in order to derive approximate local stresses for the subsequent PFC model



Simulation of mechanical properties of intact rock

Mechanical Properties	Massive Sulphides	PFC3D Model
UCS (MPa)	205	205
E (GPa)	105	104
Poisson Ratio	0.29	0.28
Tensile Strength (MPa)	4	57

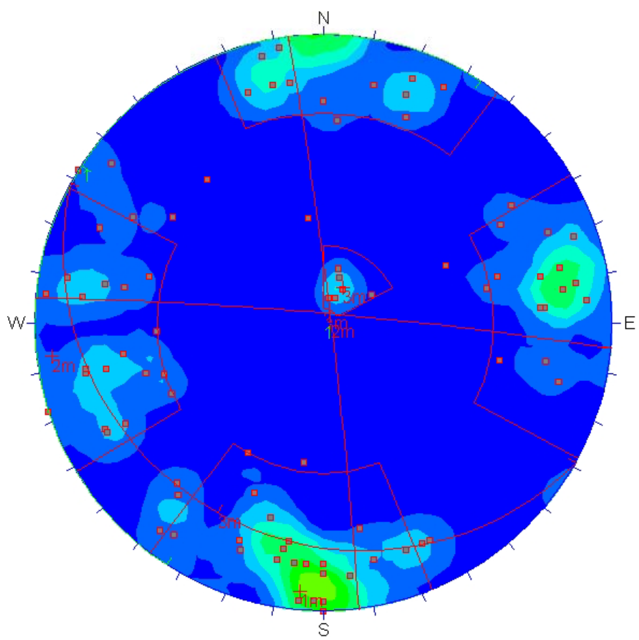


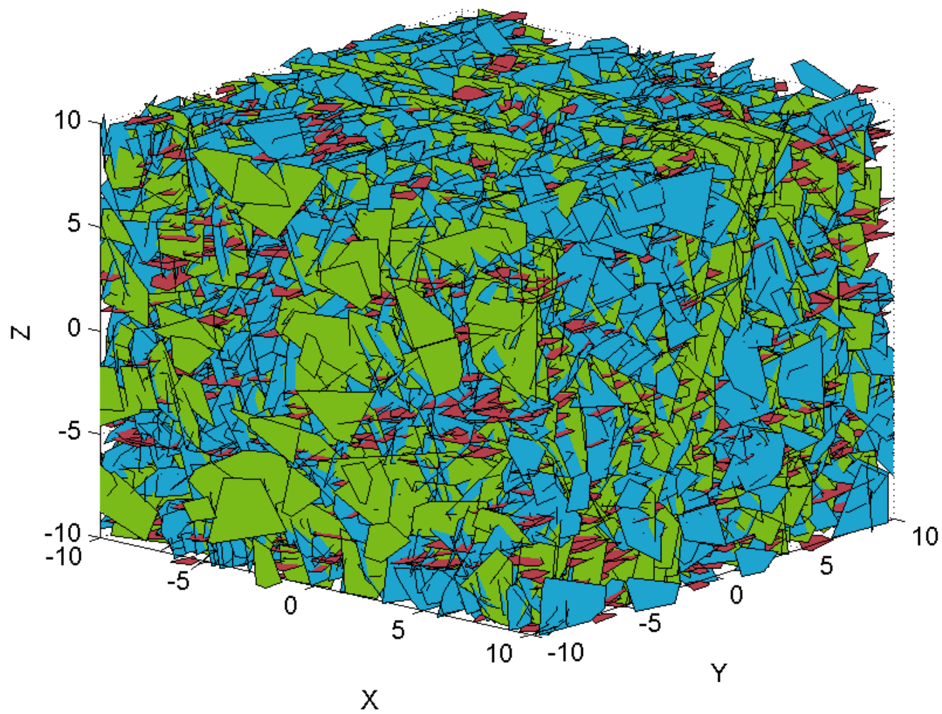
The bond elastic and strength parameters, particle size distribution, etc… were adjusted to duplicate the laboratory test results – good match, except for the tensile strength

Fracture System Model

- Scanline mapping
- Three fracture sets

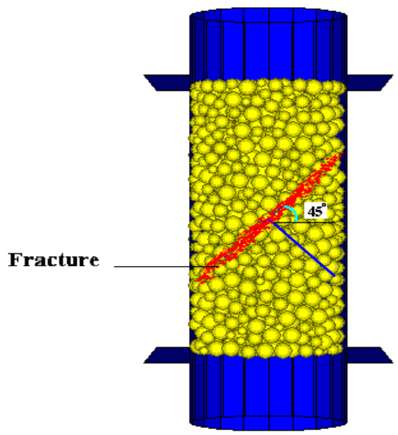
The Fracture System Model was generated using the Laval algorithm. This 3D fracture system image is only one of many possible fracture systems (due to the stochastic process).

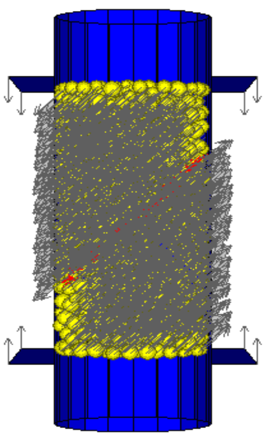




Simulation of mechanical properties of fractures

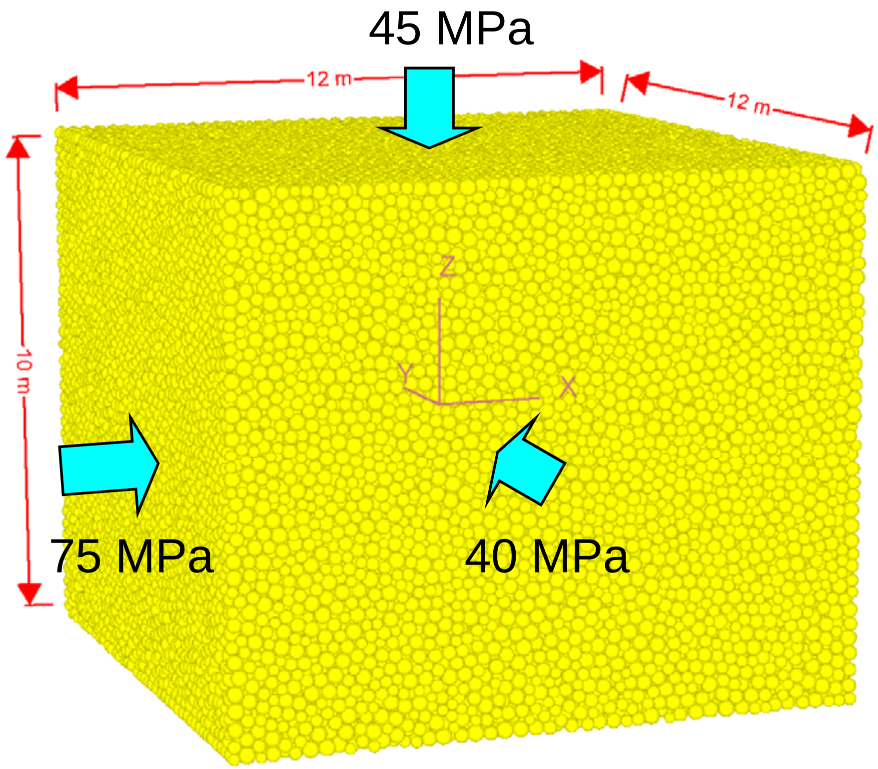
- Angle of friction 30º
- Zero cohesion



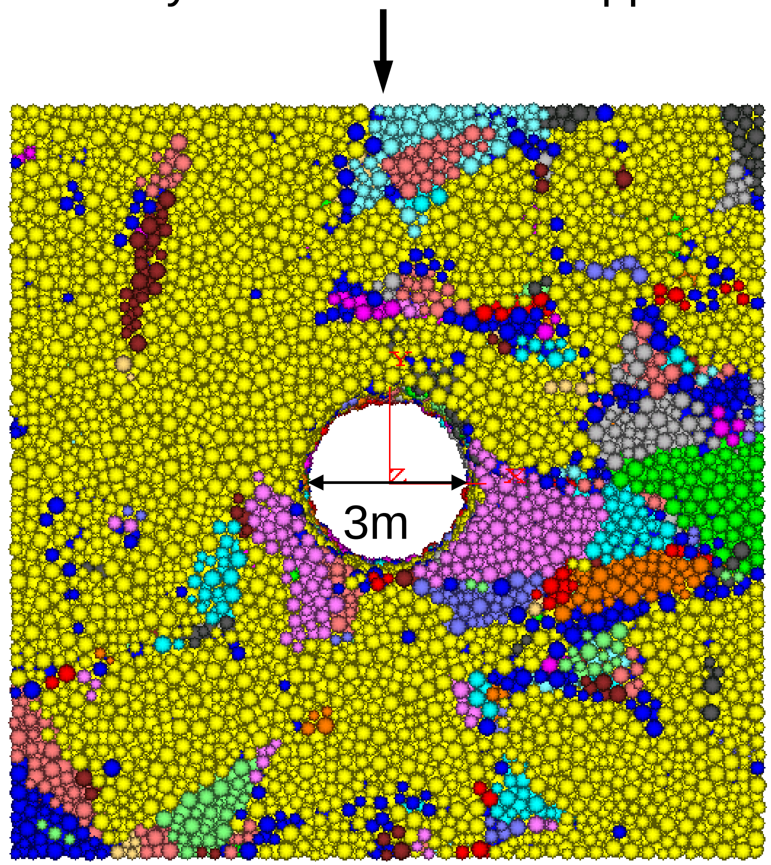


Synthetic Rock Mass Model

Fractures divide the PFC3D model (different blocks are identified by clusters of particles of different colours). Gravity acceleration was applied.

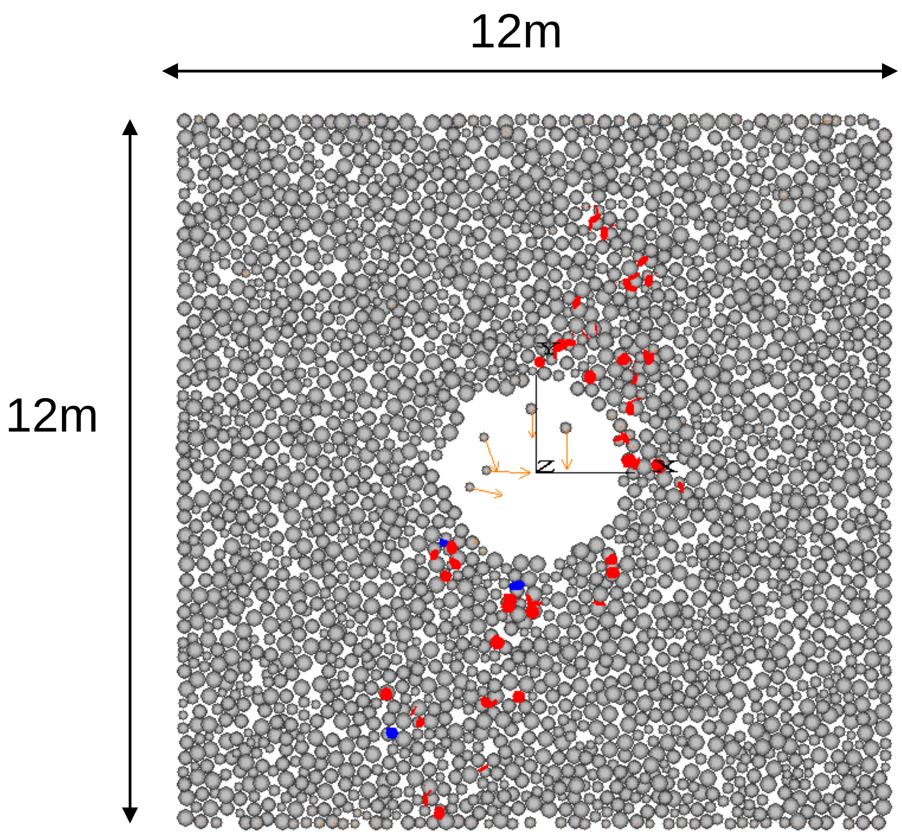


Stresses from the global model

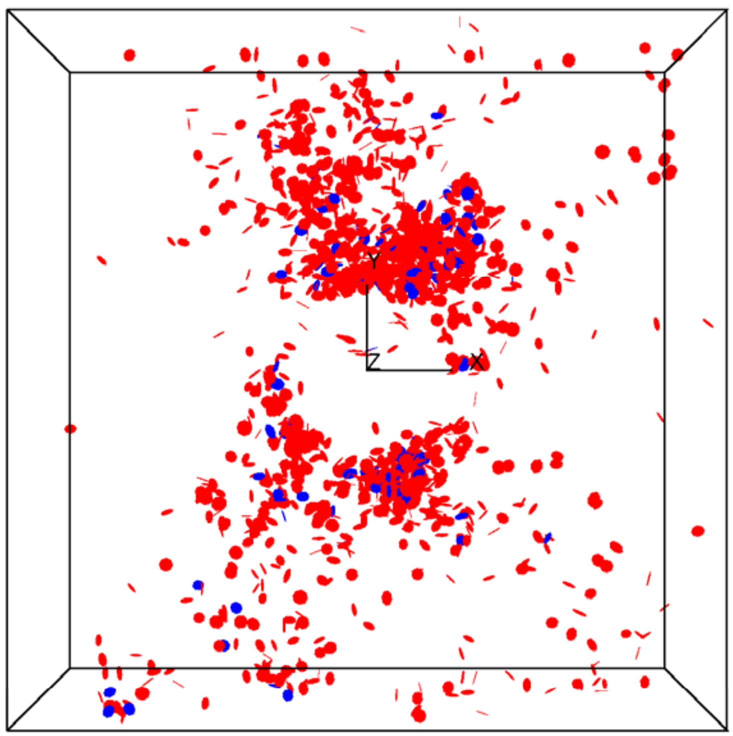


Modelled bond failures (plan views)

Normal (tension) crack; shear crack

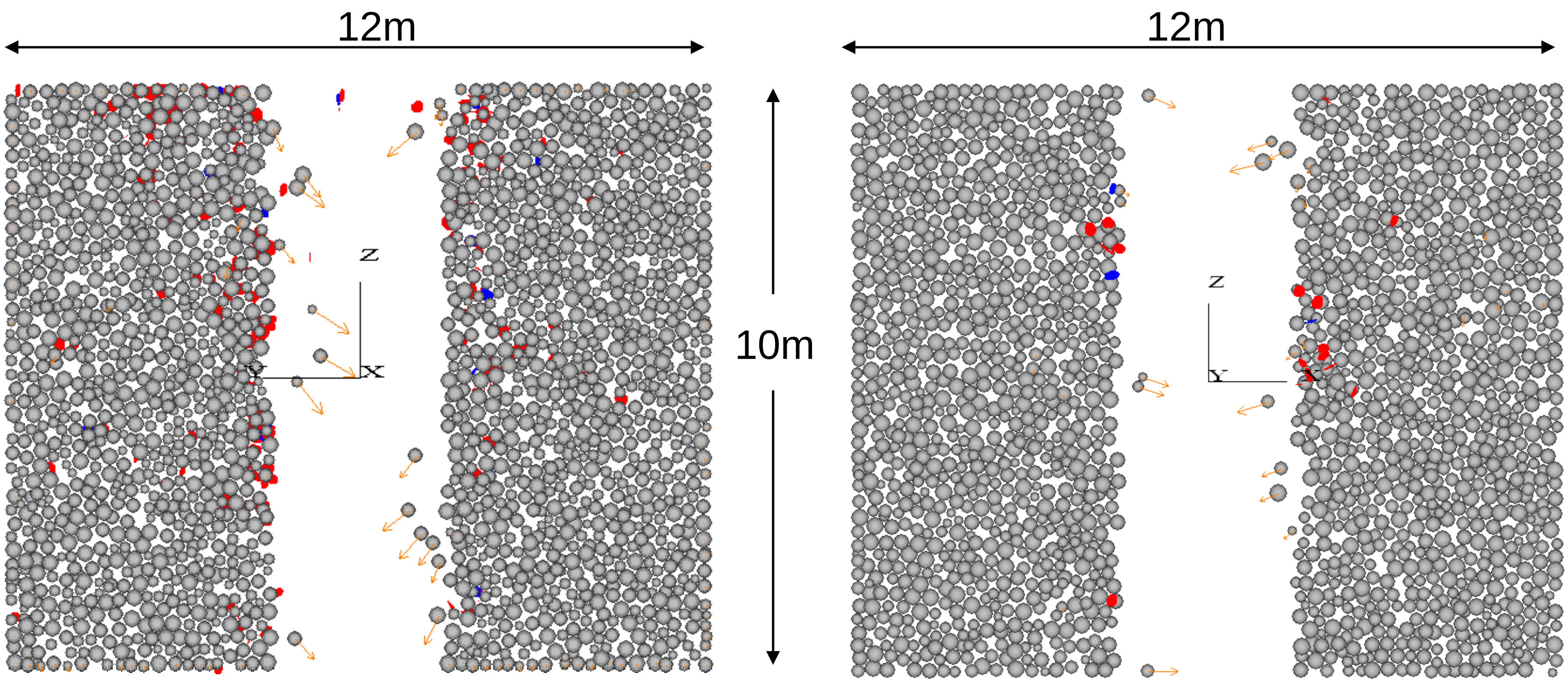


Cross-section



Plan view. All cracks found through the synthetic rock mass volume are superimposed in one plane.

Modelled bond failures (longitudinal views)

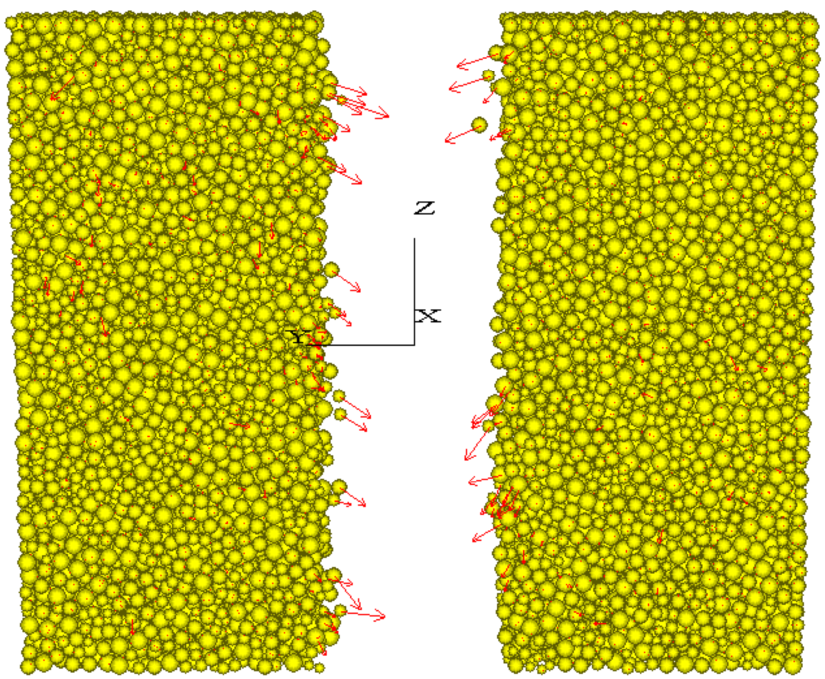


North-south section

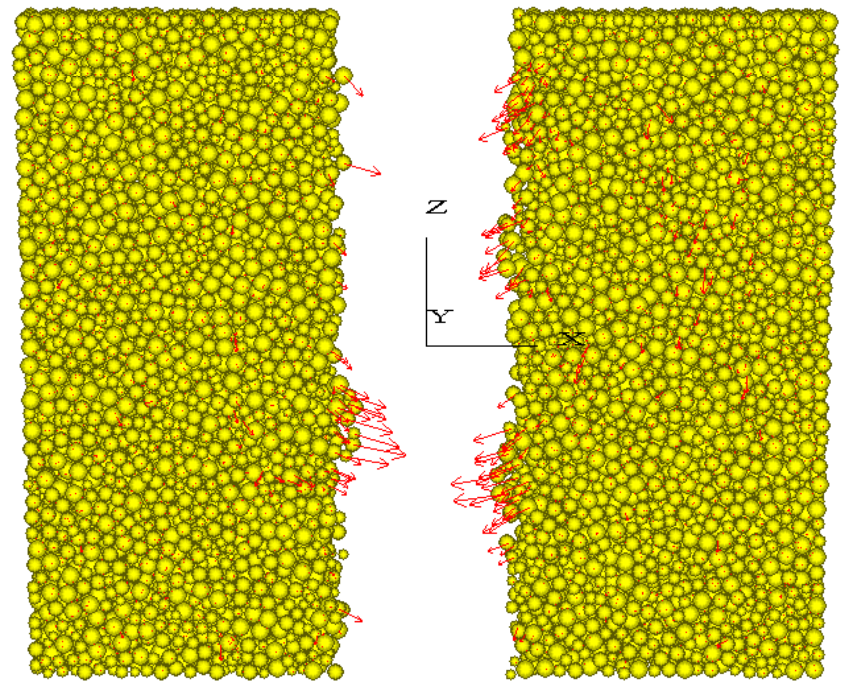
East-west section

Normal (tension) crack; shear crack

Displacement



North-south section

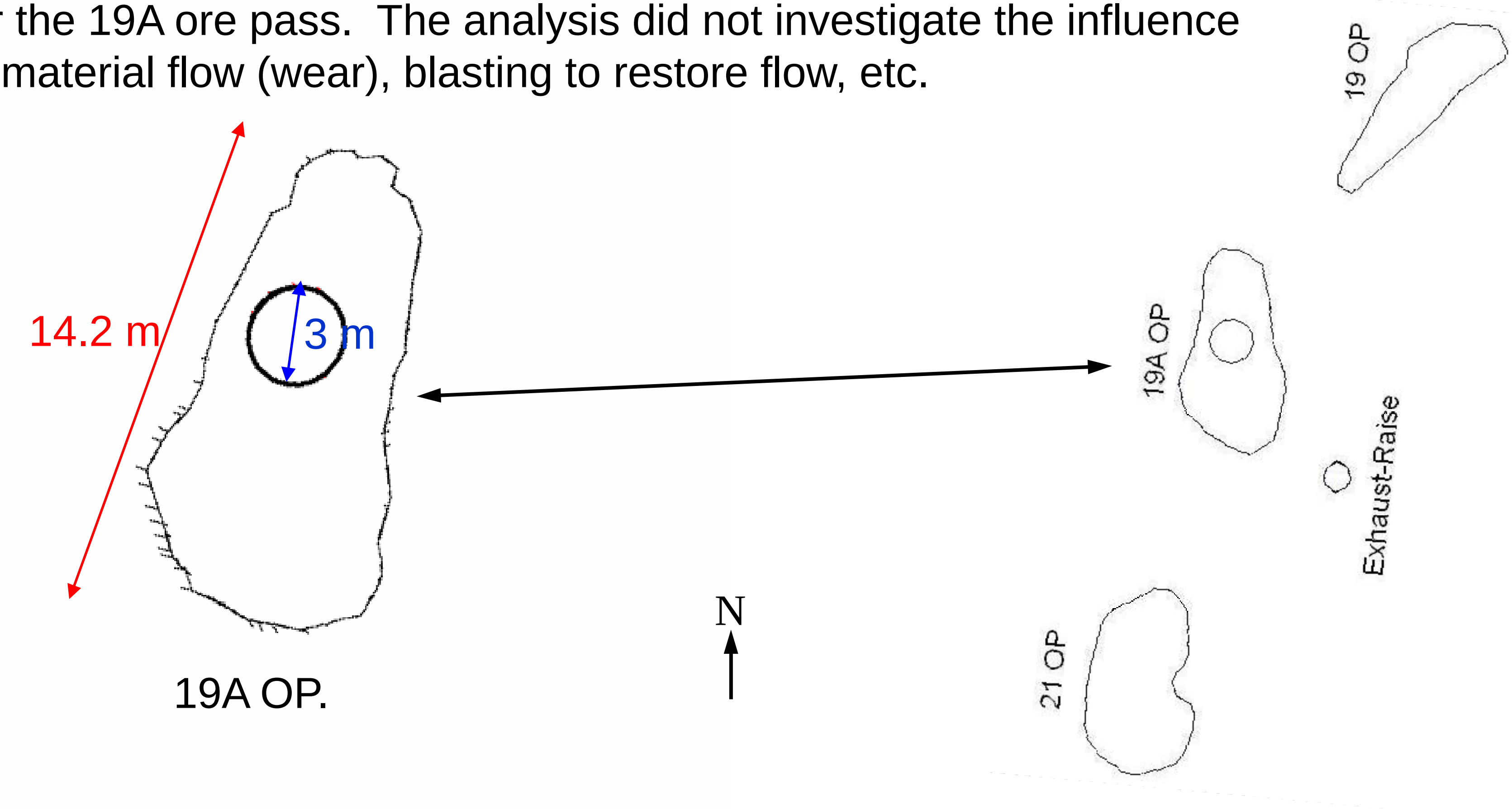


East-west section

Note that the largest displacements are along the fracture planes. Cluster movements (rock blocks) can be seen along the E-W section.

Field observations – CMS of the ore pass system (plan views)

Predicted the expansion (shape and orientation), but not the magnitude, for the 19A ore pass. The analysis did not investigate the influence of material flow (wear), blasting to restore flow, etc.



Conclusions

- The observed pattern of crack propagation in PFC3D follows the orientation of the observed ore pass degradation underground
- It did not predict the actual magnitude of the failed zone

- Concerns
  - Over estimation of tensile strength in PFC
  - Influence of material flow in the ore pass
    - It results in higher wall degradation than if this was a ventilation raise

Thank You