

# Destressing strategies for mining under highly stressed conditions in the deep mines of Sweden

## Presenter

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## Project leader

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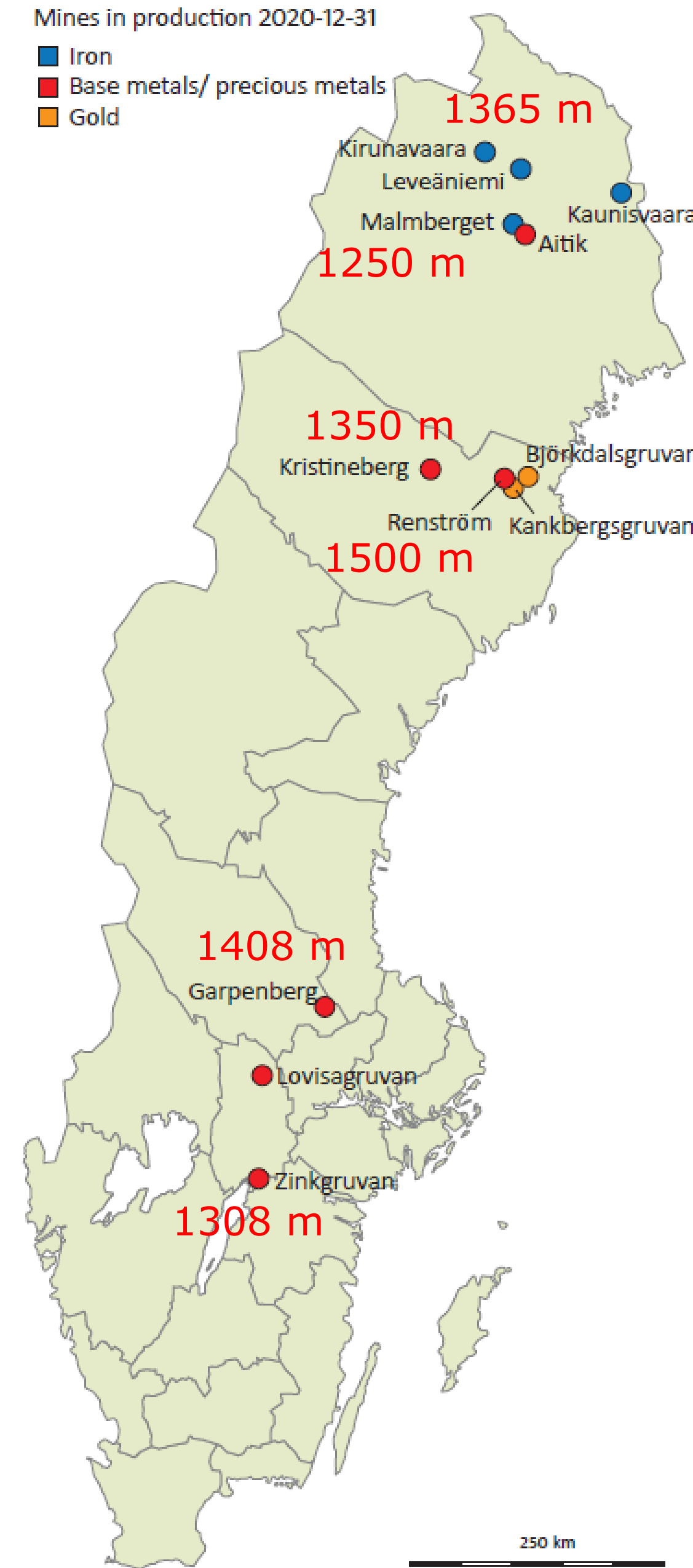
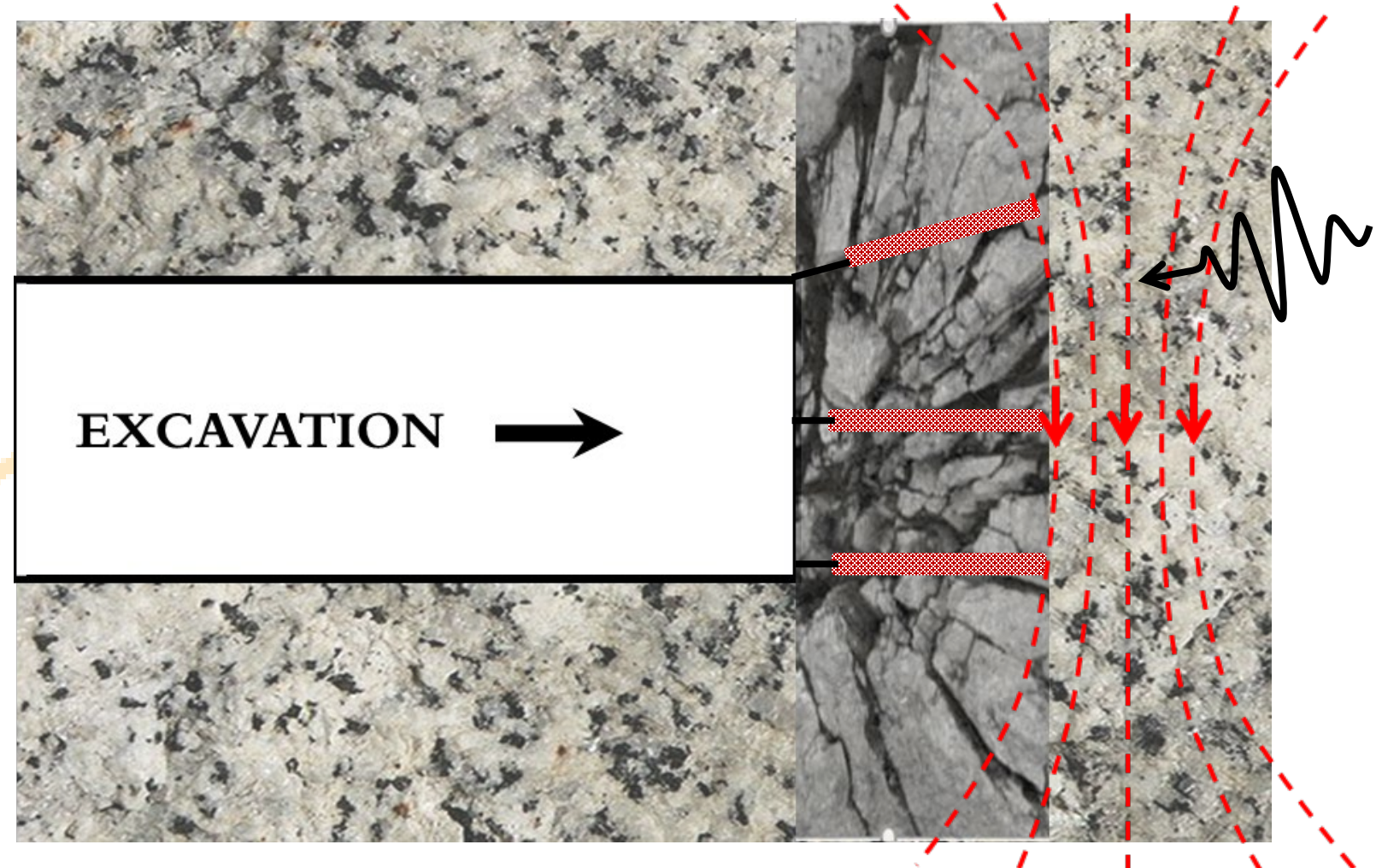
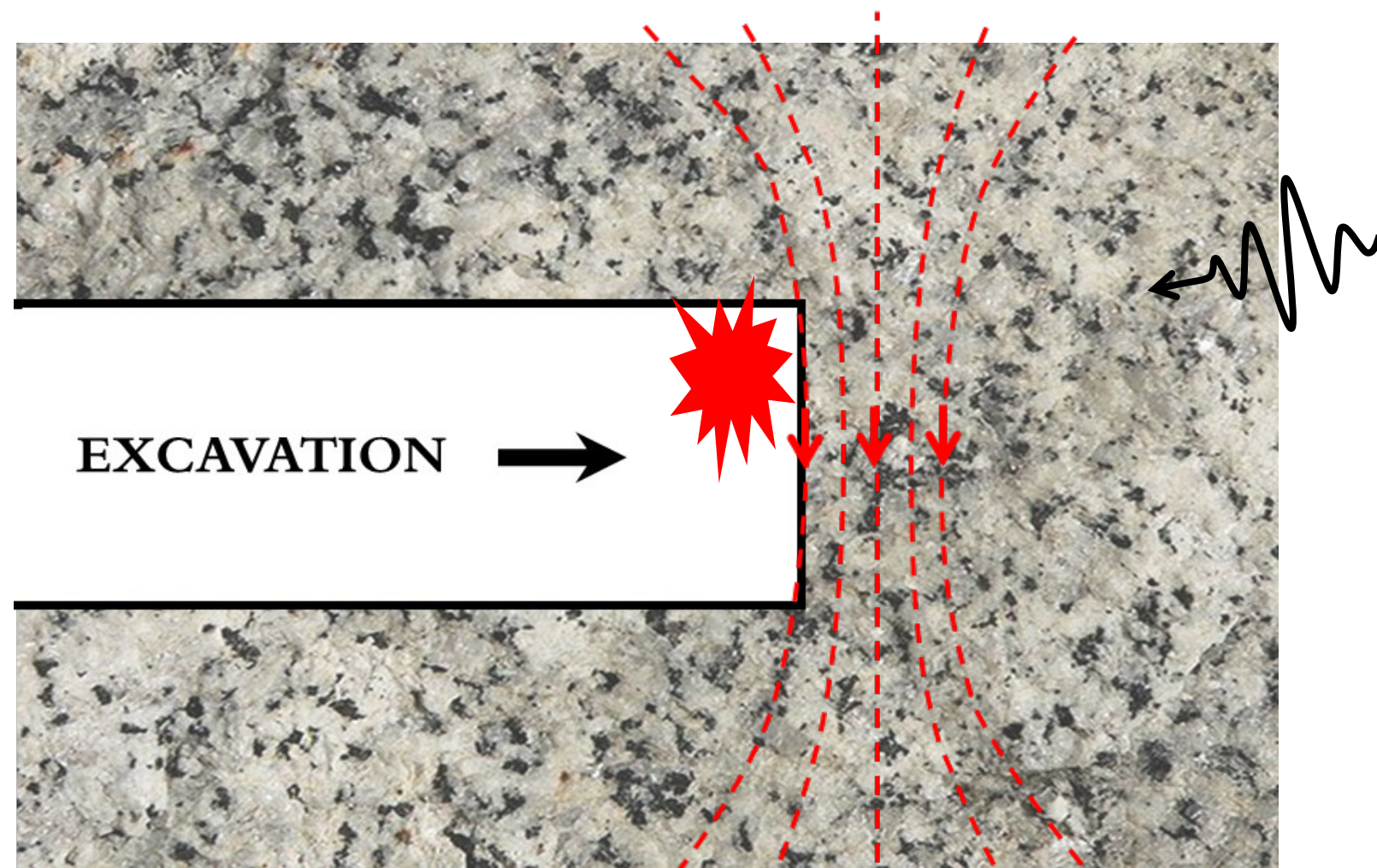
## Partners

LTU, LKAB, Boliden, Zinkgruvan Mining



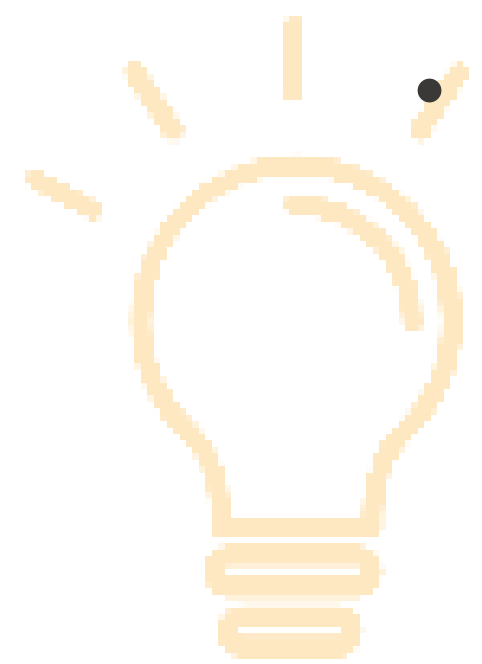
**Program Day 2023**

# Background



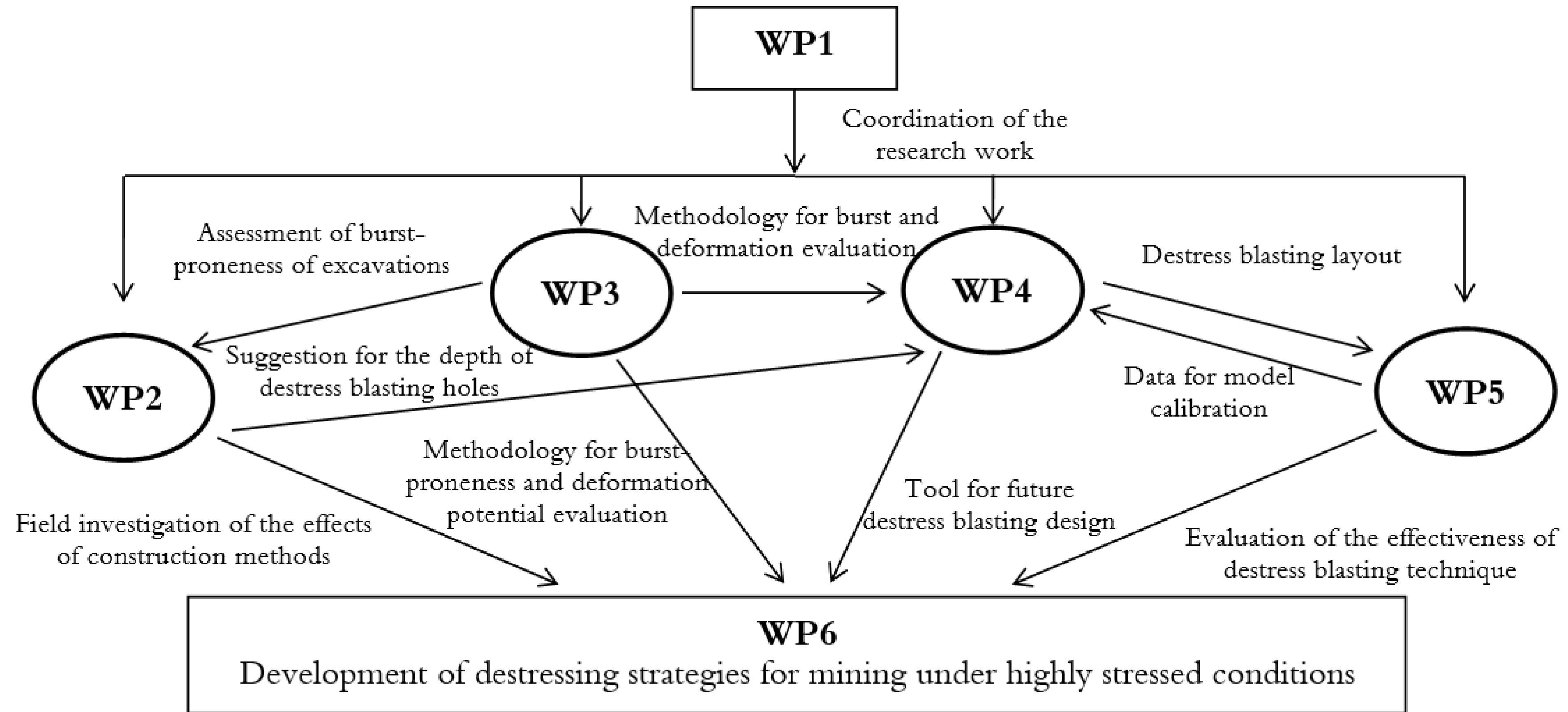
# Goals of the project

- **Improve the understanding of the effects of construction process** on the burst-proneness and deformation potential of excavations,
- **Evaluate the effectiveness of distress blasting technique** in comparison with the conventional blasting,
- **Improve the blasting design** to maximize the effectiveness of distress blasting and minimize damage to the surrounding openings, and
- **Develop destressing strategies** to mitigate rockburst risk and deformation potential under highly stressed conditions in the deep mines of Sweden.



- Expected impact of the project
  - No fatalities
  - Ground control measures that can ensure safe conditions with no unforeseen fallouts
  - Energy-effective mining processes

# Project Plan



# Project results so far

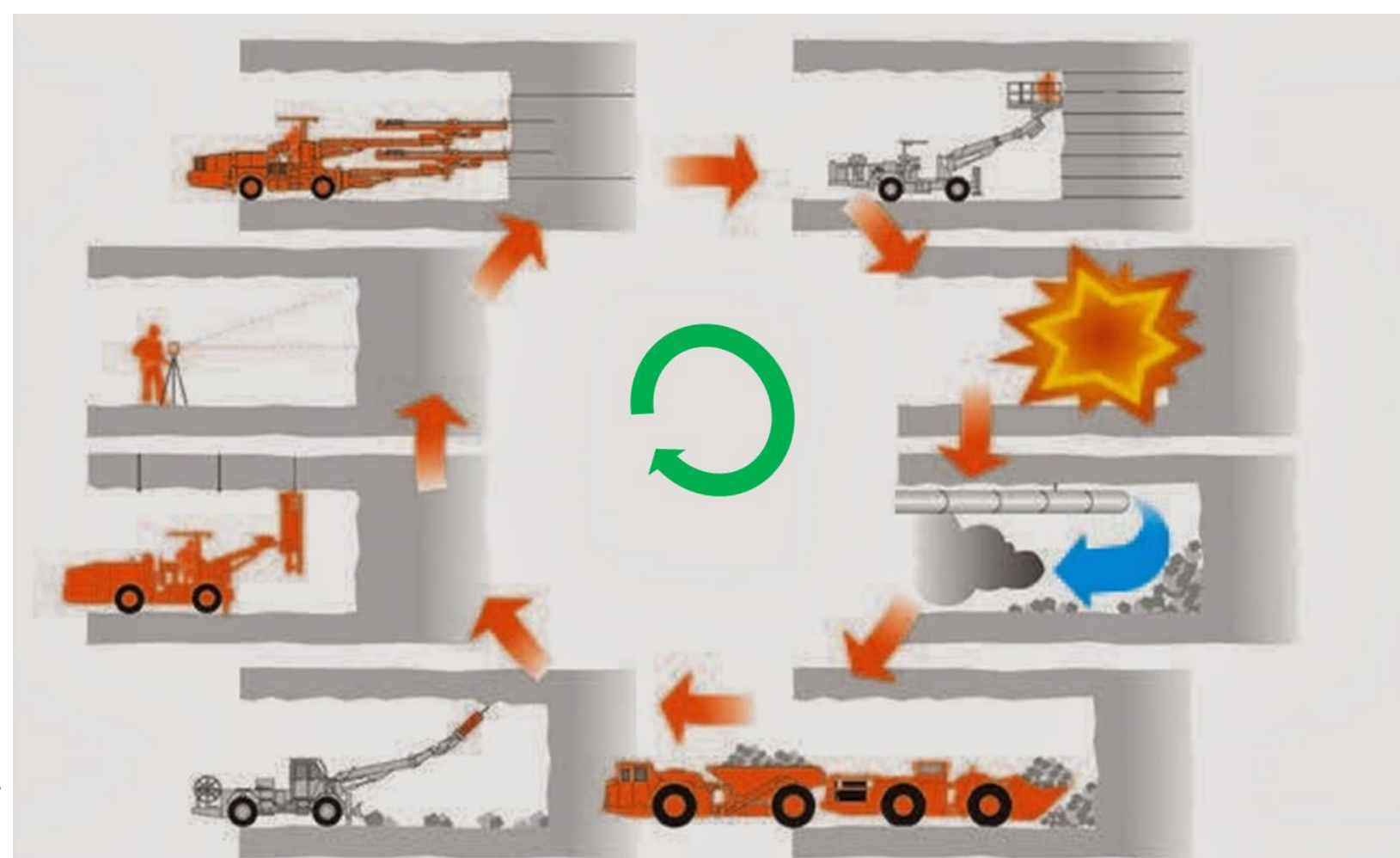
## WP2: Field investigation of construction process on the burst-proneness of excavations

Drilling

Surveying

Bolting

Shotcreting



Charging

Blasting

Ventilation

Scaling and mucking

**Form for questionnaire**

**Information of responder**

Company/Organisation \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_

Title: \_\_\_\_\_

Name: \_\_\_\_\_

Anonymity: \_\_\_\_\_

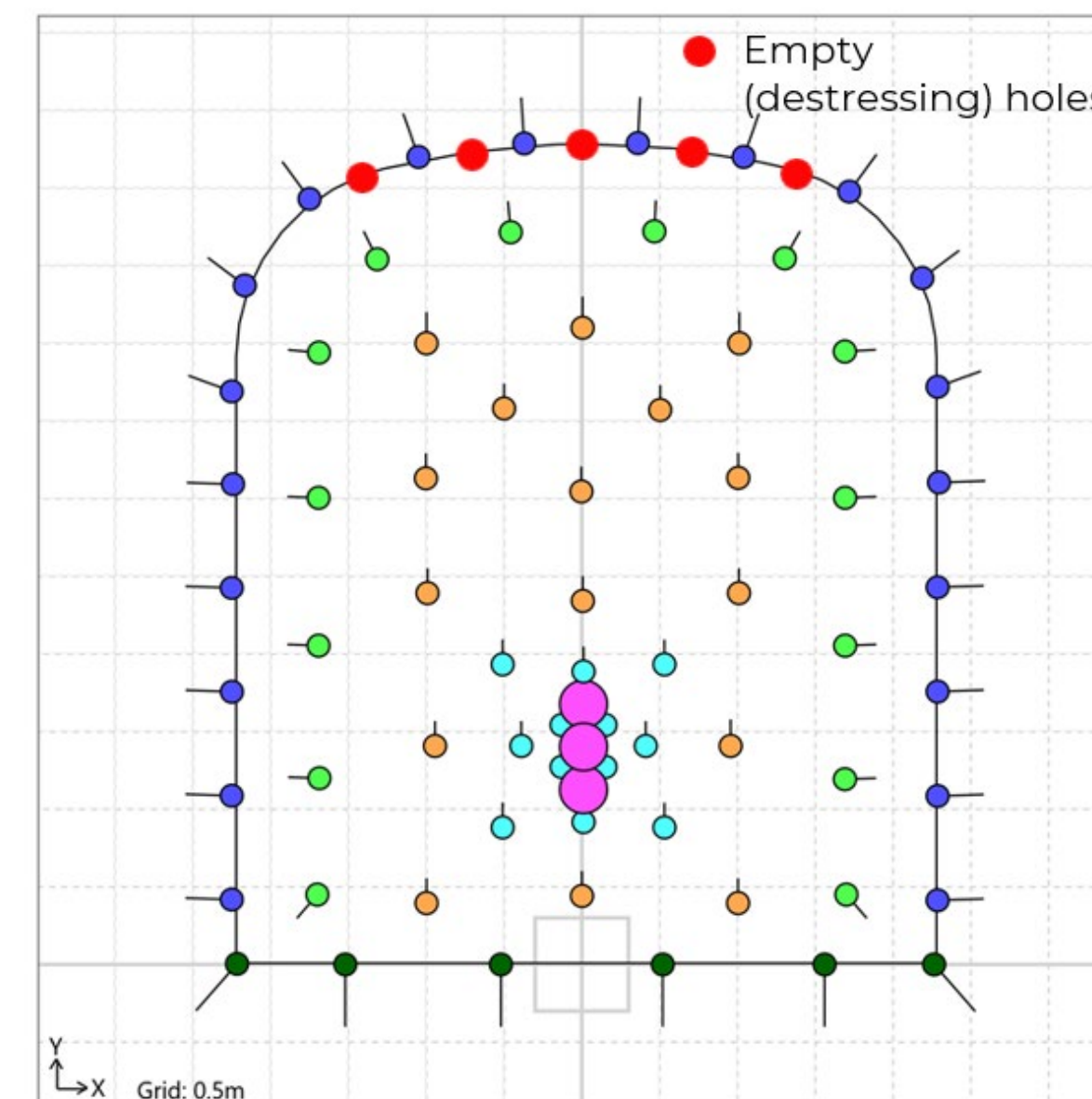
**Questions**

Question 1: How many years of experience in scaling do you have?  
\_\_\_\_\_

Question 2: At which year of experience did you feel confident if the amount of scaling, is enough for a drift?  
\_\_\_\_\_

Question 3: Is it difficult by observation of the drift if it's going to be easy or hard to scale?  
 1: Yes (If yes, elaborate)  
 2: No (If no, elaborate)

Question 4: Do you feel confident in distinguishing the different types of rock that occur in the mine (Ore/wasterock)?  
 1: Yes



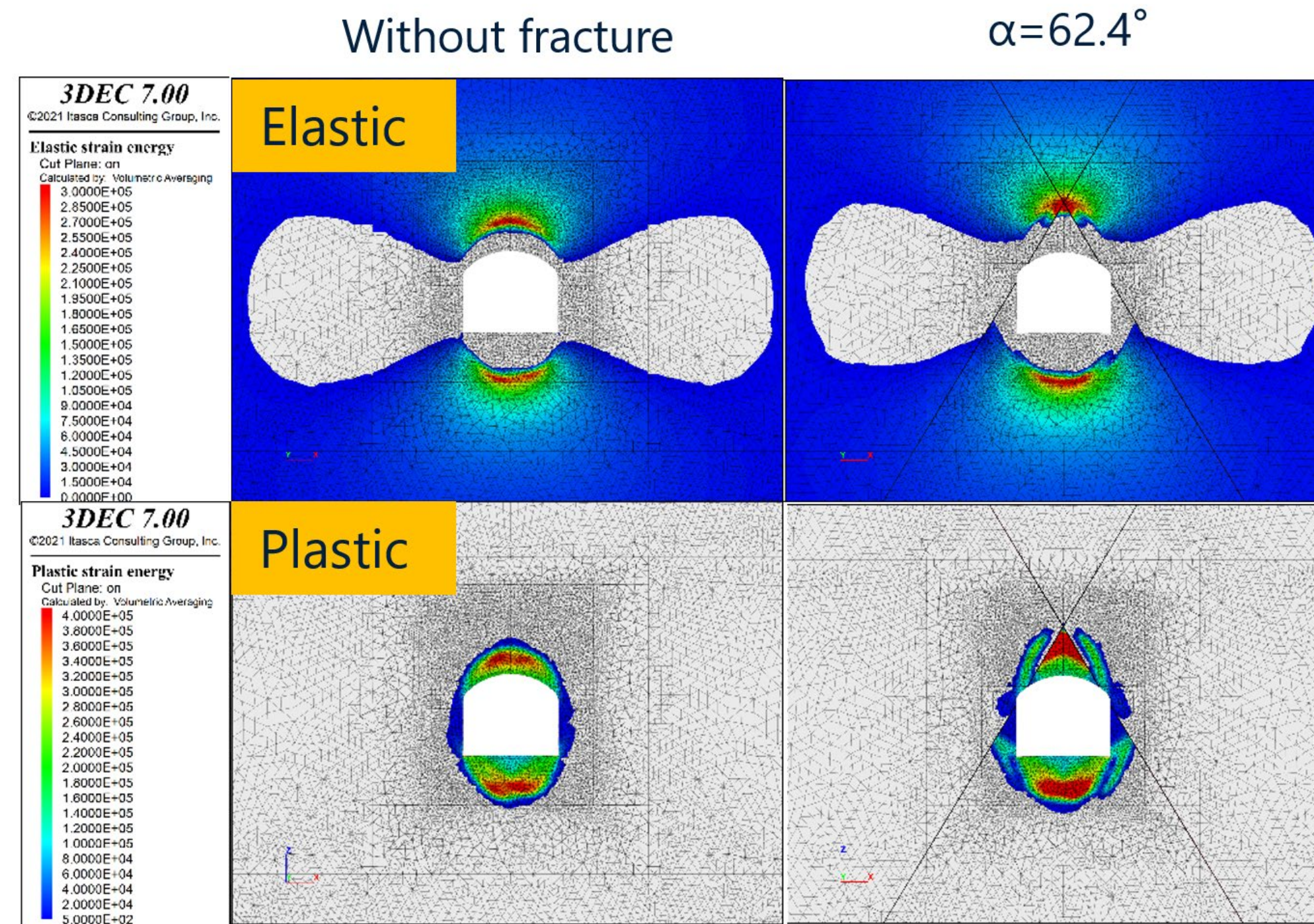
Destress drilling tests conducted

Investigation of the construction process

Questionnaire prepared for interviewing scaling operators

# Project results so far

## WP3: Development of methodology for evaluating burst-proneness



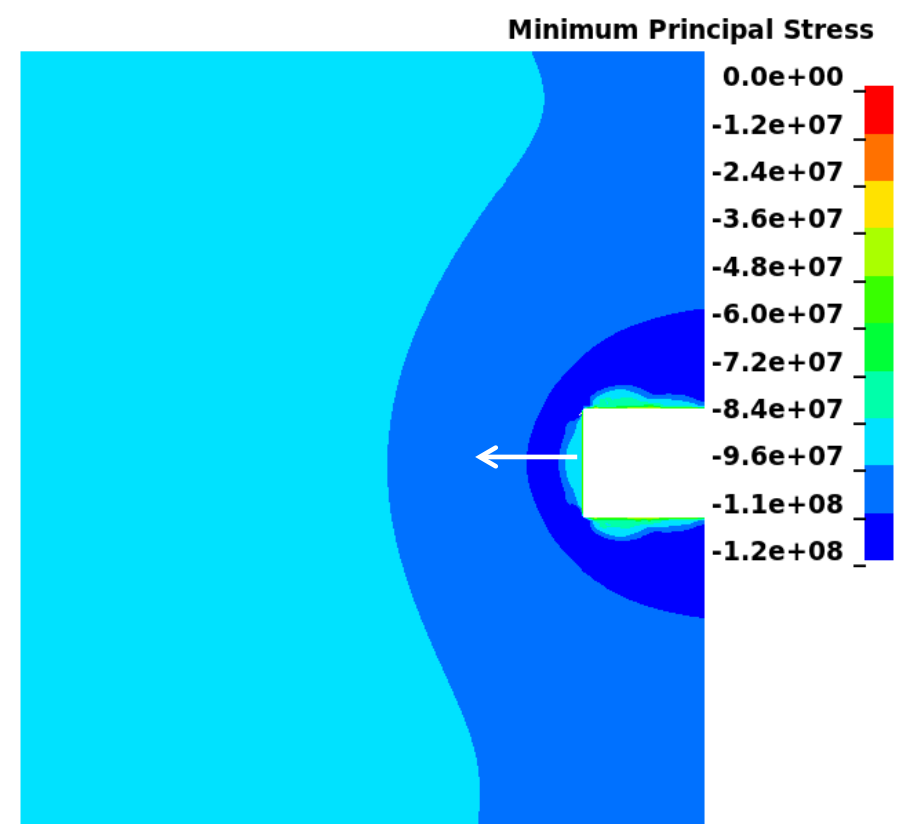
Energy parameters developed to evaluate burst potential



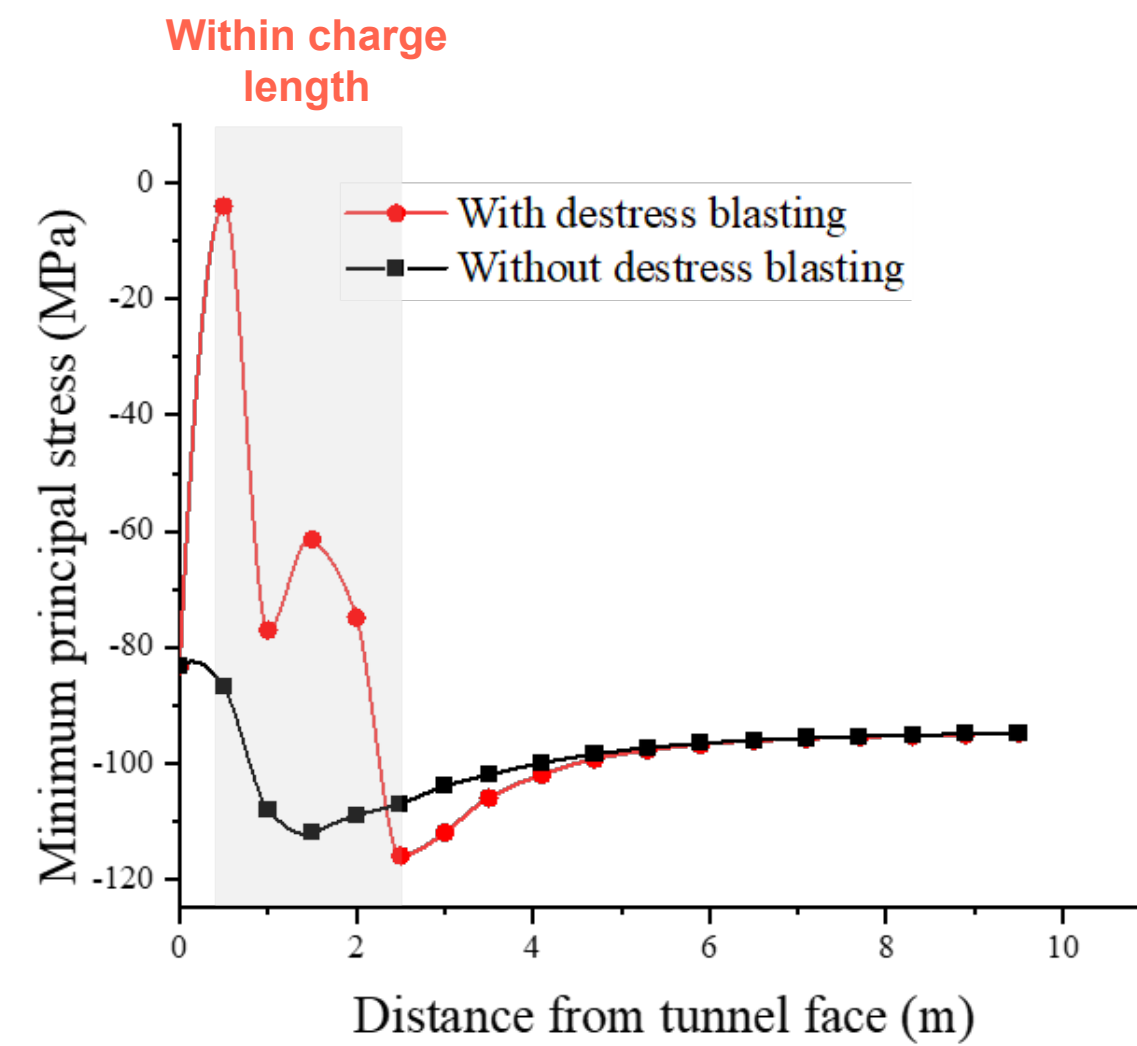
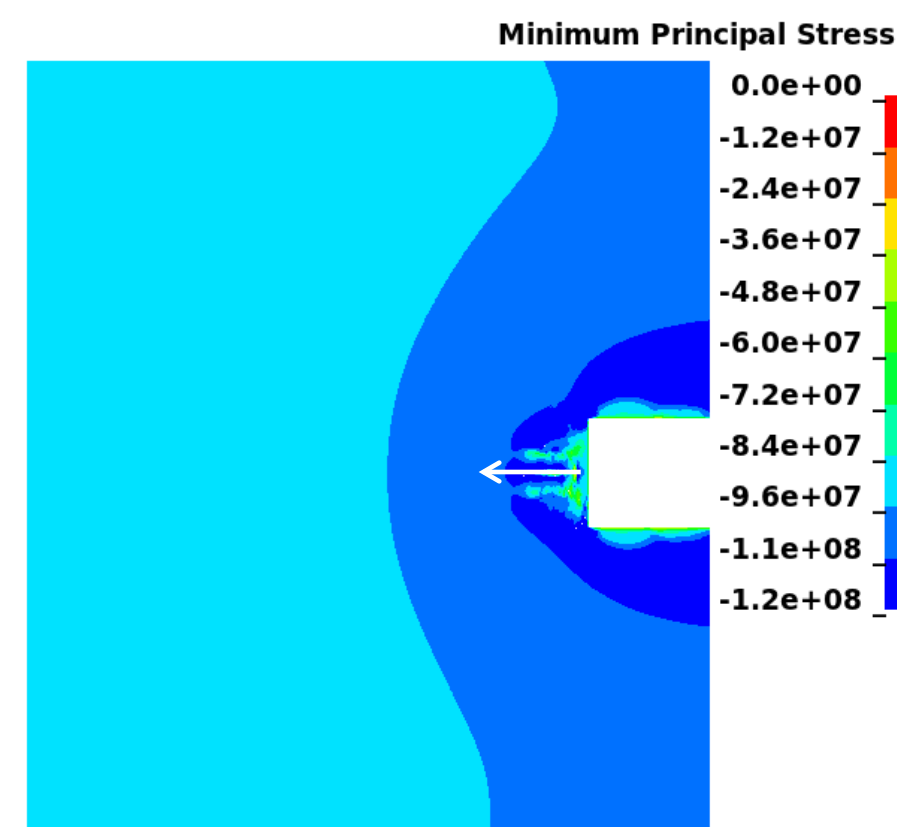
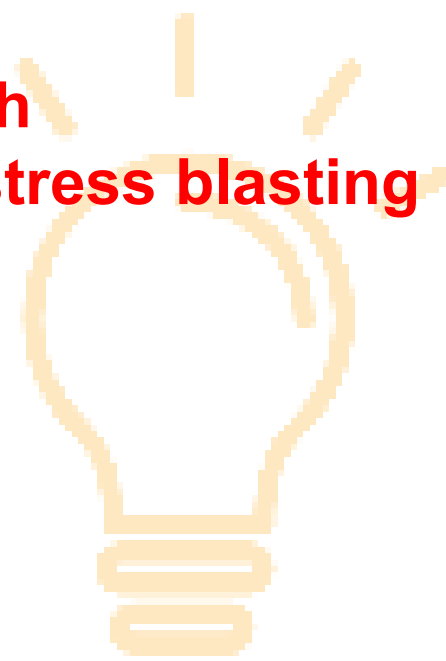
# Project results so far

## WP4: Destress blasting design and its preliminary evaluation

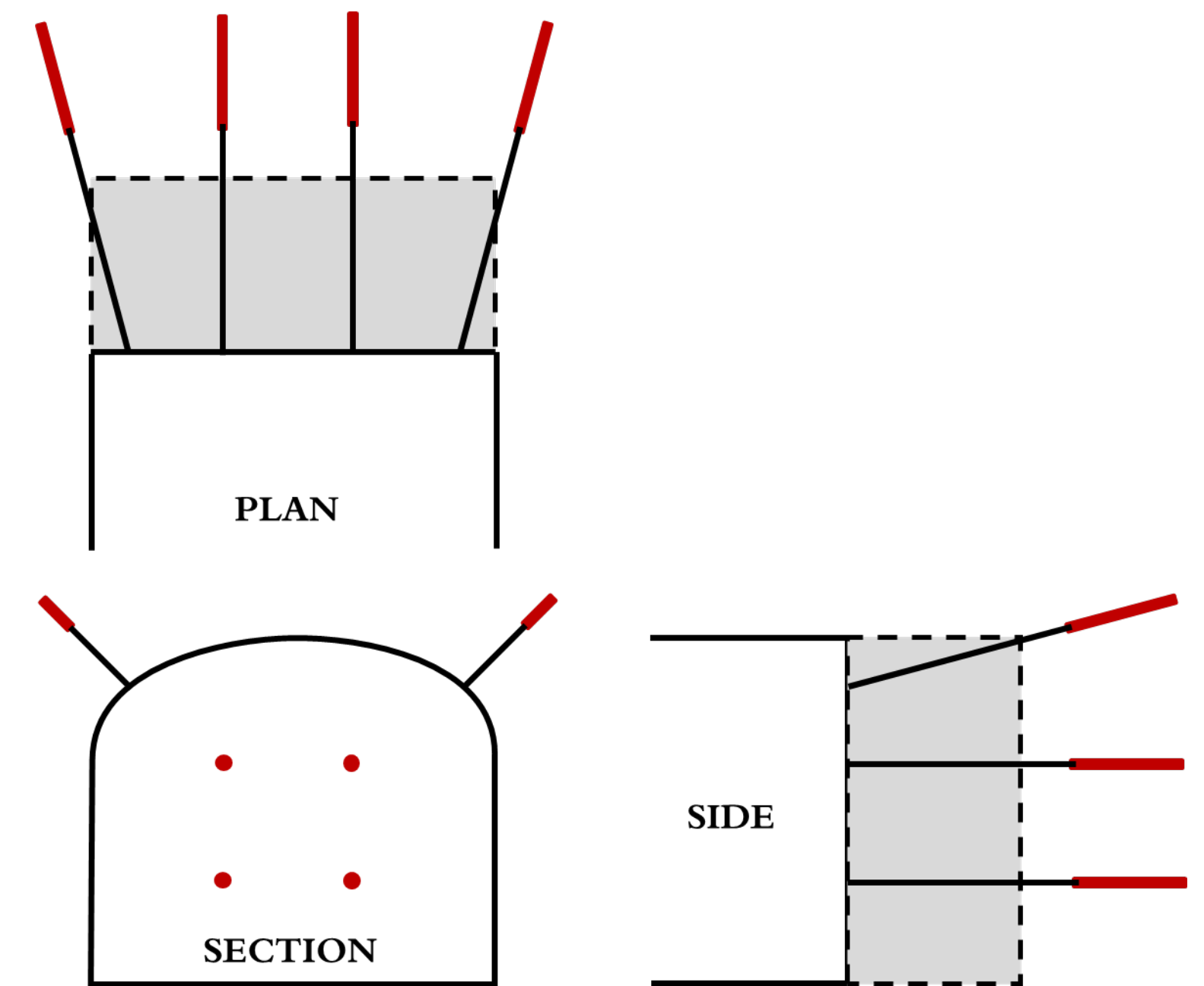
Without destress blasting



With destress blasting



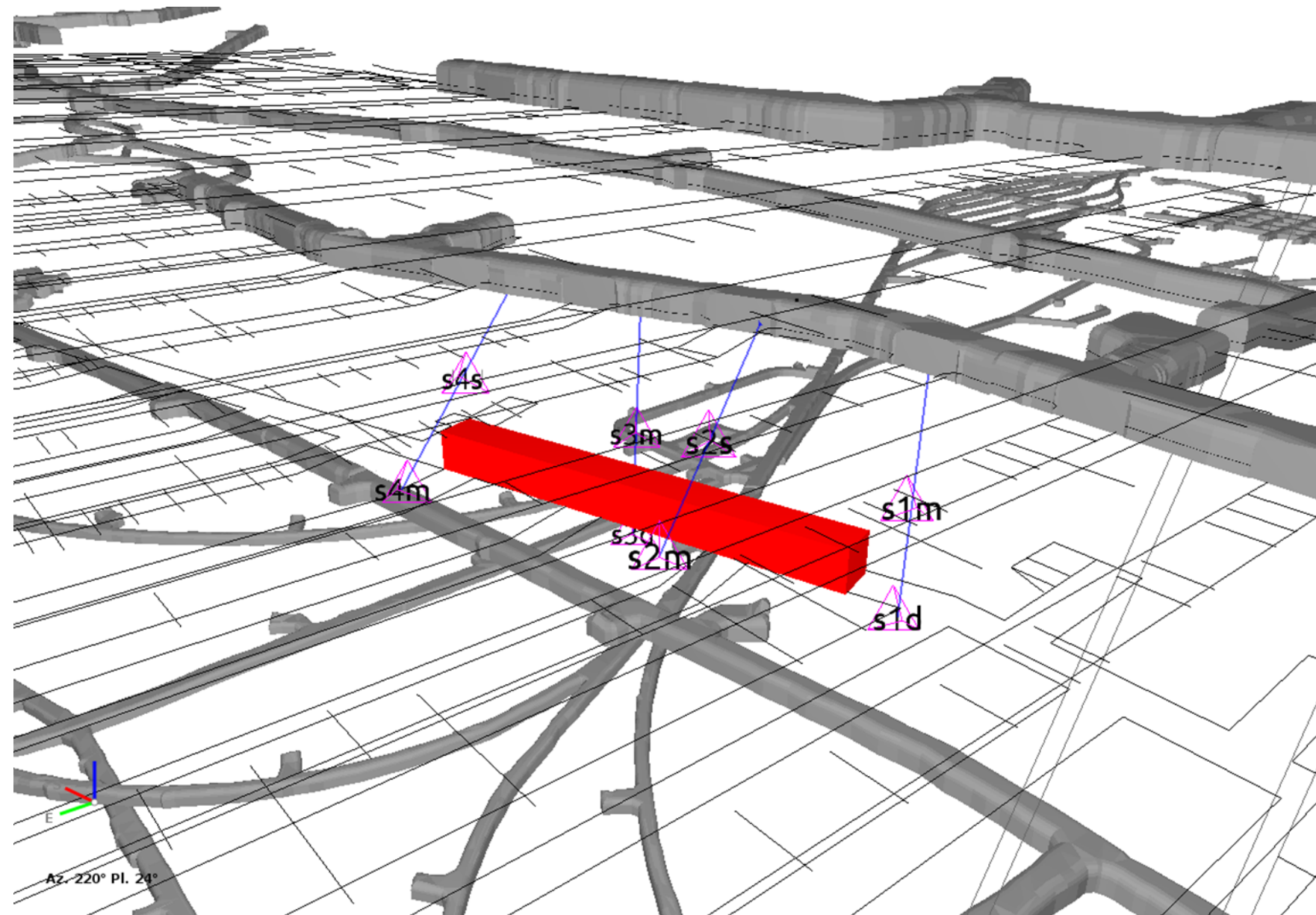
Evaluation of the effectiveness of destressing



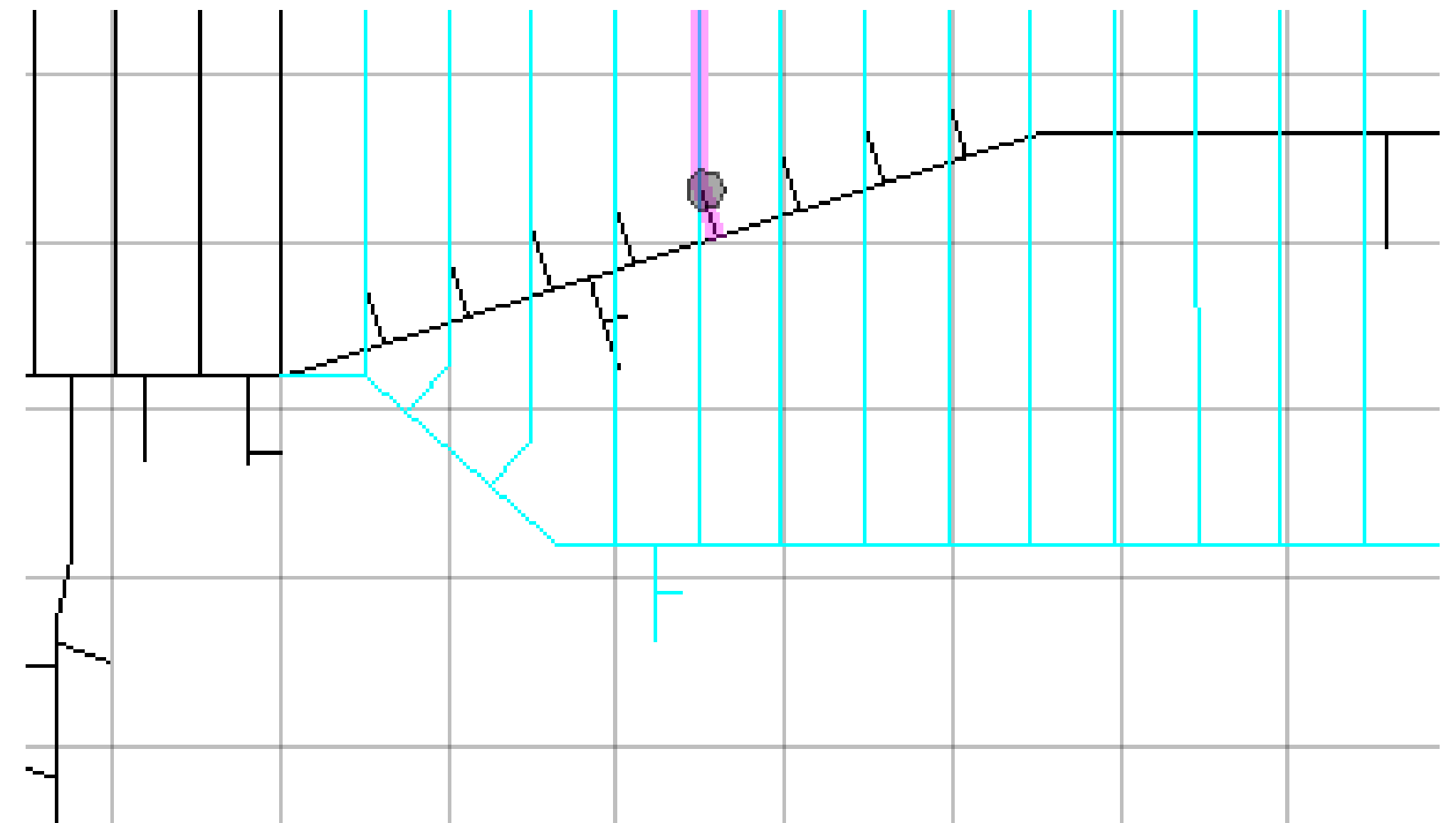
Suggested destress blasting layout

# Project results so far

## WP5: Field monitoring and numerical model calibration



**Accelerometer array design**



**Layout of the footwall drift at the instrumented site**





# Dissemination

## **SMI Program Day:**

- 2021-10-05, online
- 2023-10-26, Stockholm

## **Workshops:**

- DESTRESSING project reference group. Internal project workshops. 2021-
- Zhang P. 2023. How rock mechanics can contribute to deep and sustainable underground mining? Oulu Mining Summit, Online event, Sep 14-15, 2023

## **Conference Papers:**

- Zou Y. and Zhang P. 2023. Assessment of energy release and redistribution on excavation instabilities for underground mining. In: Proceedings of the ISRM 15th International Congress on Rock Mechanics and Rock Engineering & 72nd Geomechanics Colloquium – Challenges in Rock Mechanics and Rock Engineering, Schubert W. & Kluckner A. (eds), Salzburg, Austria, October 9-14, 2023, Austrian Society for Geomechanics: Salzburg, pp. 313-318.
- Zhang P. 2022. Rockburst management at LKAB's Kiirunavaara Mine: what can we learn from COVID-19 management. In: Potvin Y. (ed.). Caving 2022: The Fifth International Conference on Block and Sublevel Caving, Australian Centre for Geomechanics, Aug 30-Sep 2, Adelaide, pp. 1135-1146.
- Ylmefors A., Zhang P. and Mozaffari S. 2022. Classification of mining induced seismicity at the Kiirunavaara mine. Rockburst and Seismicity in Mines (RaSiM10), Apr 26-28, Tucson, 14p.

## **Thesis:**

- Andreas Ylmefors. 2023. Classification of mining induced seismicity at the Kiirunavaara mine. Master thesis, Luleå University of Technology, 50p.



# Next Steps

- Install instruments and conduct field tests at Kiirunavaara Mine
- Calibrate numerical models
- Develop destressing strategies for mining under highly stressed conditions
  
- 6th workshop scheduled (November 15, 2023)
- 3 journal papers to be submitted
- 1 conference paper to be submitted to MassMin2024 conference (Sep 17-19, Kiruna)



# Mining innovation for a sustainable future