Project title

Stress changes in underground mines - from theoretical investigation to practical recommendations

Project leader
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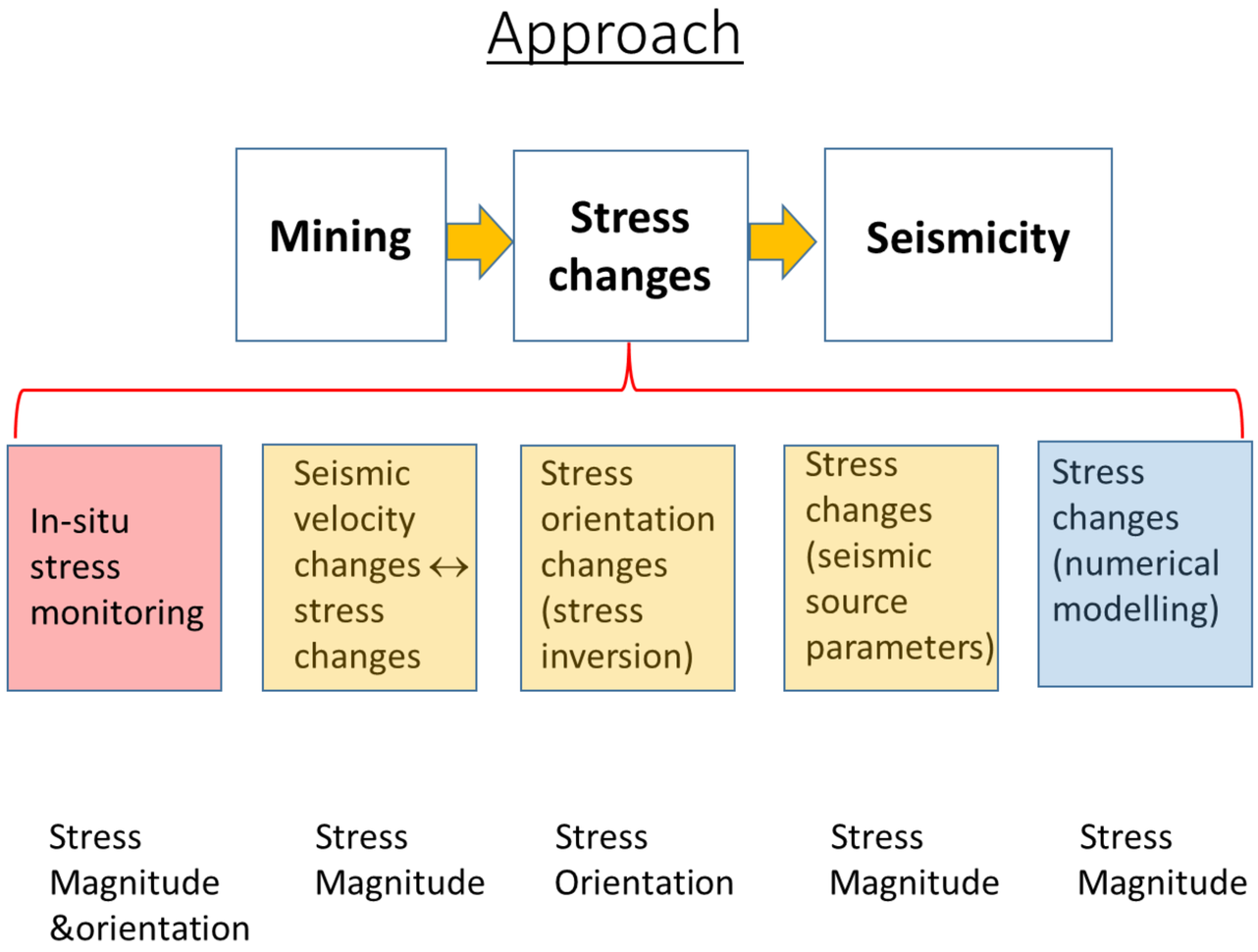
Partners
LKAB (Kiruna and Malmberget mines), Boliden (Garpenberg mine), Lundin Mining (Zinkgruvan), Uppsala University

Project duration
2022-03-01 – 2025-08-31

SWEDISH MINING INNOVATION

Med stöd från
VINNOVA Sveriges innovationsmyndighet
Energimyndigheten
FORMAS
Strategiska innovations-program

Goals of the project



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Goals of the project

Scientific goals (related to the underlying cause of mining-induced seismicity):

- ❑ To define which stress proxies can be used for mapping of stress changes in the mines
- ❑ To define relationships between stress changes and induced seismicity in connection with the production sequencing, production rate, and geological environment

Practical goals:

- ❑ To develop practical tools for using the geophysical methodologies for mapping stress changes and recommendation for using them in the mines
- ❑ To develop recommendations for using the results for short-to medium term seismic hazard

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Results so far

- Obtaining results or collecting data for :

❑ seismic wave velocity changes

❑ stress orientation from stress inversion

❑ numerical models

❑ seismic source parameters

- Installation of in-situ stress cells for stress monitoring; analysis of the data
- Developing of methodology for analysis of the data and relationships between seismic source parameters, numerical model data, velocity changes
- Developing of methodology for stress inversion, and relationship between stress inversion results and stress cell in-situ measurements
- Visual correlation between different stress proxy parameters

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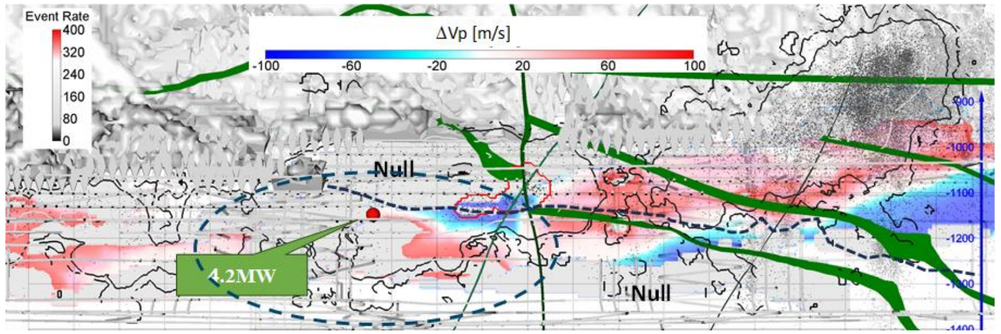
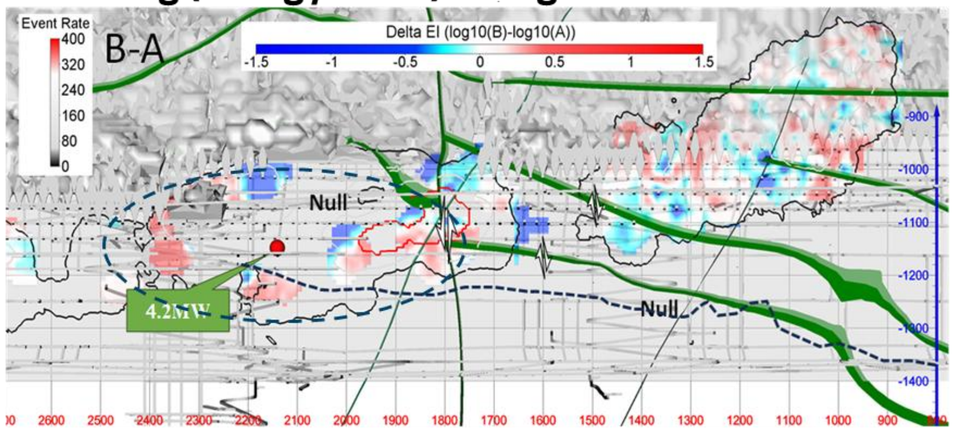
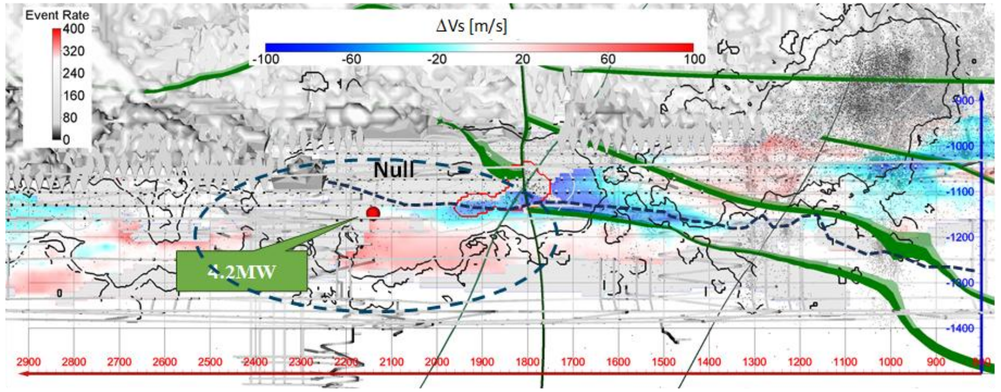
Results so far

Vp velocity change after the event

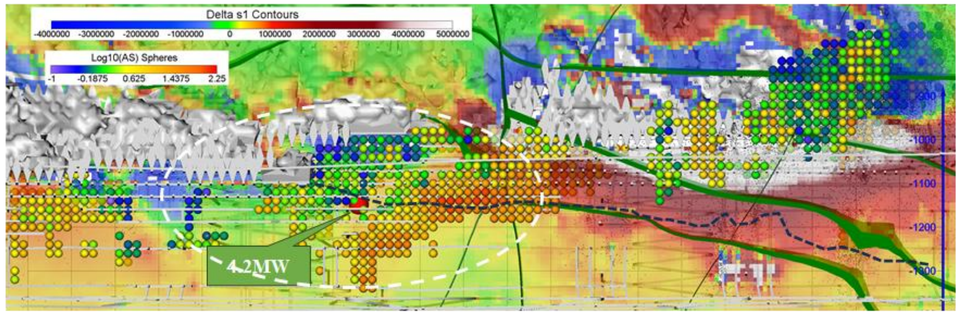


Log (Energy Index) change after the event





Vs velocity change after the event



Modelled stress change vs Apparent Stress after the event

Comparison of changes in seismic wave velocity, energy index, apparent stress and modelled stress changes before and after the M4.2 seismic event in Kiruna mine

(American Rock Mechanics Association symposium, Colorado, July 2024)

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Upcoming activities and next step

Stage 1

- Finalizing the seismic wave tomography
- Finalizing the methodology for obtaining relationships between seismic source parameters, numerical model data, and seismic wave velocity changes
- Developing methodology for obtaining relationship between stress changes and seismicity depending on the production and the geology
- Developing and applying methodology for cluster analysis and stress inversion for large volumes in the mines

Stage 2

- Developing practical tools for:
  - Obtaining proxy data and using it for stress mapping in the mines
  - Routine use of stress changes for short-to-medium term seismic hazard

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Mining innovation for a sustainable future

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