Development of criteria due to seismic risk for temporary closing/re-opening of seismically active mines

Utveckling av kriterier på grund av seismiska risker för tillfällig stängning / återupptas seismiskt aktiva gruvor

**LTU – project leader**

Projektets syfte och mål

To find criteria for increased risk for damage or injuries
due to rockbursts (for specific area and time)
that could be used for warning the mine personnel and
closing areas

Projektets syfte och mål

1. To define relationships between seismic hazard and mining process (time dependent hazard) based on

   ➢ statistics of seismic source parameters and correlation with production

   ➢ correlations between seismic hazard and stress changes due to mining

2. To define correlations between seismic hazard and damage hazard (seismic risk) based on

   ➢ correlations between seismic source parameters and damage parameters

3. To develop criteria and recommendations for closing certain areas in the mines, and subsequent re-opening based on relationships (1-2)

Projektets syfte och mål
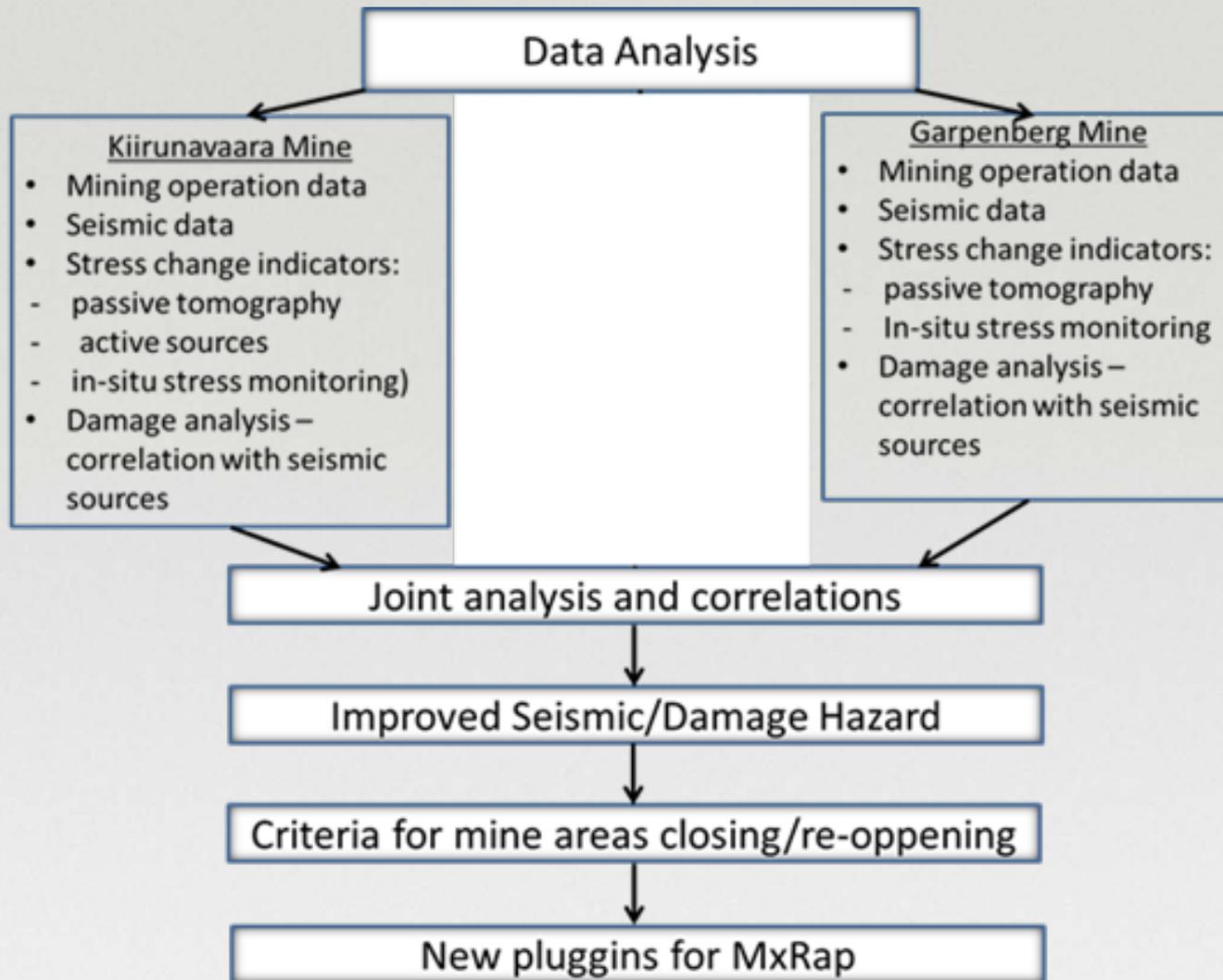
Projektets syfte och mål

Final goals:

- to improve safety and productivity, by improvement of
  - mine planning,
  - mining sequencing, and
  - ground control strategy in seismically active mines

- to reduce the risk of personal injuries caused by seismic events

Resultat hittills

Data collection, analysis, developing methods and tools

1. Temporal and spatial variations of the seismic source parameters in Block 33/37-34 in Kiruna Mine from May 11, 2010 until January 2017 (80 months) (production at levels 964, 993, 1022) were studied.

2. Seismic and stress data are in a process of compilation and analysis (Kiruna and Garpenberg Mines) (on-going task).

3. Analysis of the seismicity after blasting is under way

4. Preliminary analysis of the seismicity after strong events (aftershocks) and stress change modelling for some events in Kiruna Mine

5. Seismic source paremeters of 70 damaging events in Kiruna Mine are obtained. Focal mechanism and correlation with damage are under way (Master thesis).

Resultat hittills

Data collection, analysis, developing methods and tools:

6. Correlation between seismic hazard and production in Kiruna Mine just started (new industry PhD student just started)

7. New mXrap tools for data analysis and correlation are under development

The worldwide experience was studied and four possible cases identified for closing mine areas:

1. Before large events
2. After large events
3. After production blasting
4. Increased stresses and seismic hazard (for specific areas)

Kommande aktiviteter/Nästa steg

Four possible cases identified for closing mine areas:
1. Before large events
2. After large events
3. After production blasting
4. Increased stresses and seismic hazard (for specific areas)

1 → Seismic or stress indicators for increased probabilty for larger seismic events need to be found

2 → Statistics based on previous events is needed and methods for modelling of stress changes due to large seismic event to be developed

Kommande aktiviteter/Nästa steg

Four possible cases identified for closing mine areas:
1. Before large events
2. After large events
3. After production blasting
4. Increased stresses and seismic hazard (for specific areas)

3 → Statistics based on seismicity after blasting (distance from blasting, duration of increased seismicity, magnitude of seismic events)

4 →

- Stress changes study (direct measurements or indirect - velocity changes) (data compilation and velocity change monitoring)
- Correlation between seismic hazard – stress changes - production

Kommande aktiviteter/Nästa steg

All on-going task will continue:

1. In-situ stress data collection and analysis (Kiruna Mine)
2. Seismic data compilation and re-processing (Garpenberg Mine)
3. Installation of active sources and monitoring of seismic wave velocity changes will start in August 2017
4. Literature reviews for different parts of the project

One more PhD student is starting on June 1, 2017 (today)