Real-time size distribution measurement of particulate matter in a mine

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Background

- Chile-Finland mining sector collaboration in the project **Particles and noise in sustainable mining environment (HIME)**
- Collaboration encompasses e.g. researcher exchange, joint measurement campaigns in mines and their neighborhoods in Finland and workshop in Santiago de Chile
- Project belongs to the Green mining –programme* funded by the Finnish Funding Agency for Innovation (Tekes)

*http://www.tekes.fi/en/programmes-and-services/tekes-programmes/green-mining/

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HIME - Particles and noise in sustainable mining environment

Needs

Particulate matter (PM) and concomitant noise from mining operations, engines and ore processing may have adverse effects on the health and well-being of workers and of population living nearby.

Approach

The project investigates PM and noise in mining by using comprehensive experimental setups. The data collected mainly on real-time basis will enable source/process-specific exposure and health risk assessment.

Benefits

- Novel data on potentially hazardous airborne exposures in mining
- Key information on management methods of PM and noise
- New monitoring and control technologies tested

Users

- Mining companies: environmentally friendly and safe operation
- Companies providing modern monitoring and control technologies

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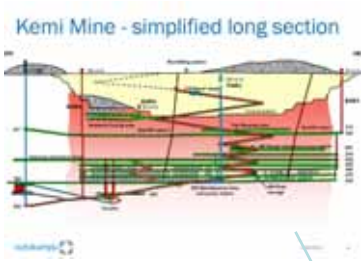
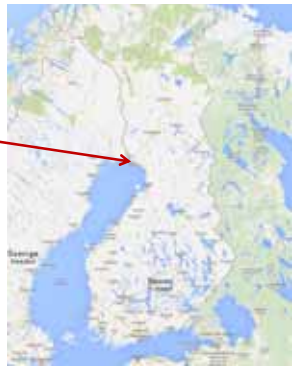
Location

- Mining in the challenging Arctic climate

Outokumpu Chrome, Kemi

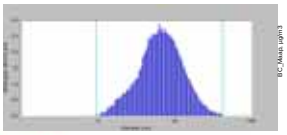




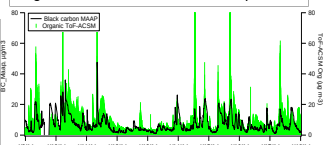
Use of the data and results

- New information from the HIME project enables source/process-specific exposure and health risk assessment and cost-effective management of local particulate matter pollution
- Joint publications, material for PhD thesis

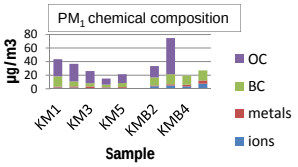
Particle size distributions



High time-resolution chemical composition



PM_1 chemical composition



Instrumentation

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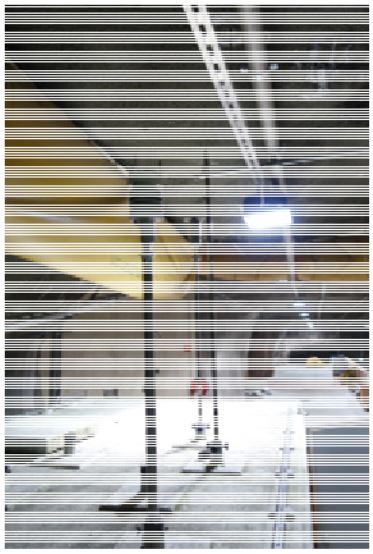
Instrument sampling inlets



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ELPI+™: Electrical Low Pressure Impactor

- Number size distribution and concentration
  - Real-time, 10 Hz
- 6 nm - 10 µm
  - 14 size fractions
- Particles are collected
  - Enables subsequent chemical analysis on the collected samples
- Wide dynamic range
  - From outdoor air to power plant stack concentrations

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ELPI+™ Operating Principle

- Operation based on three main components:

1. Impactor
   - Particle size fractionation
2. Charger
   - Particle are charged before fractionating
3. Electrometers
   - Current distribution - directly proportional to number distribution
   - Fast, sensitive

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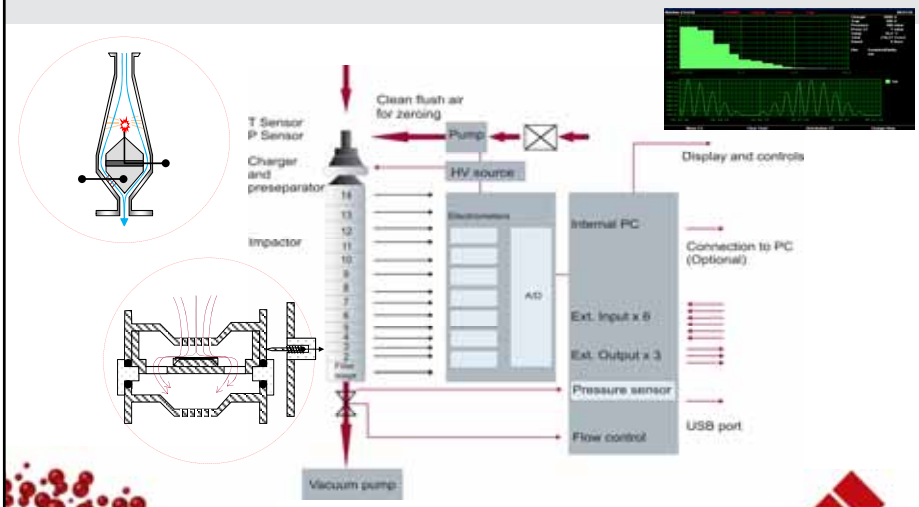
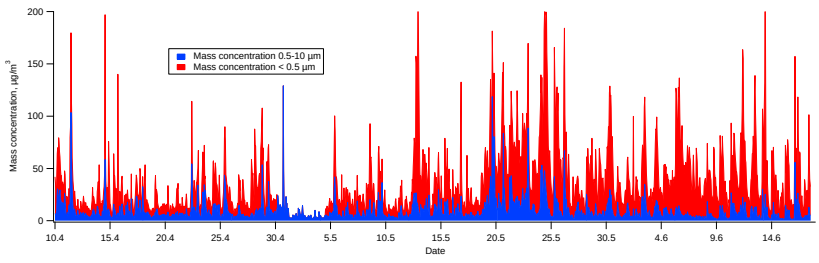
ELPI+™ Operating Principle

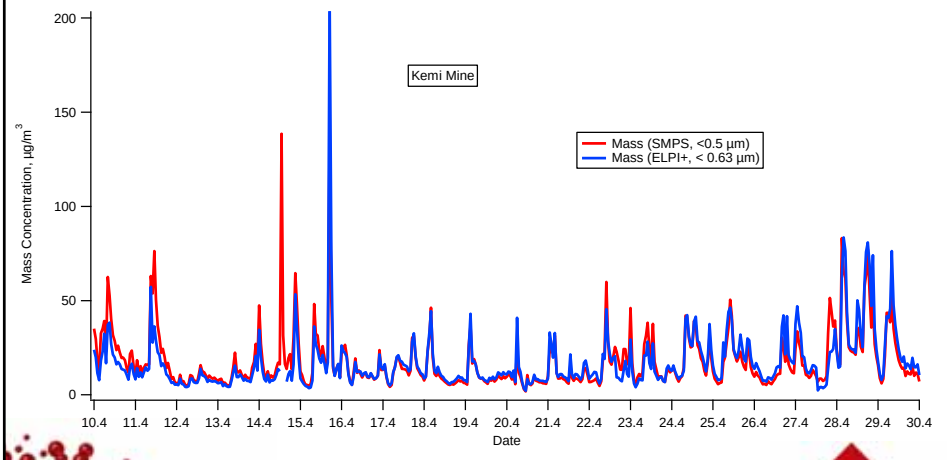


Mass concentration (ultra)fine/coarse

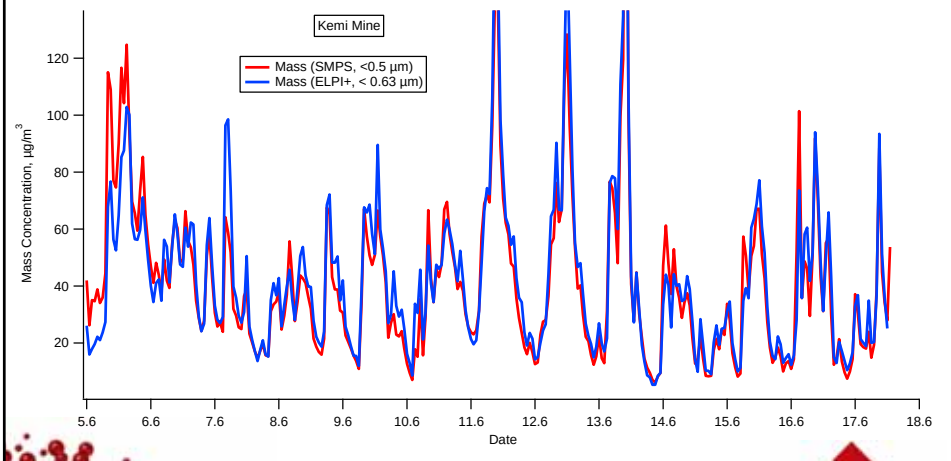
- Fine particles (D_a < 0.5 µm) originate from diesel exhaust
- Coarse particles are mainly mineral dust



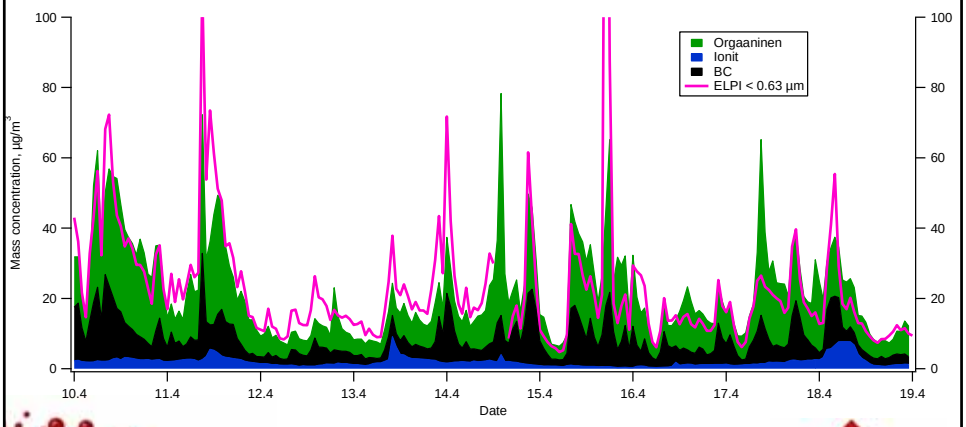
Mass correlation, different techniques



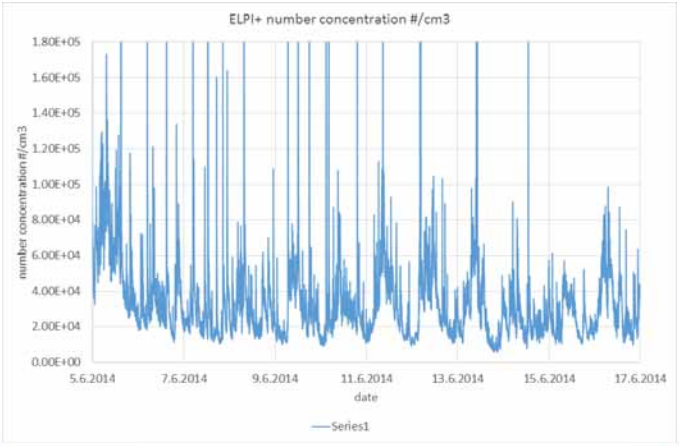
Mass correlation, daily activity



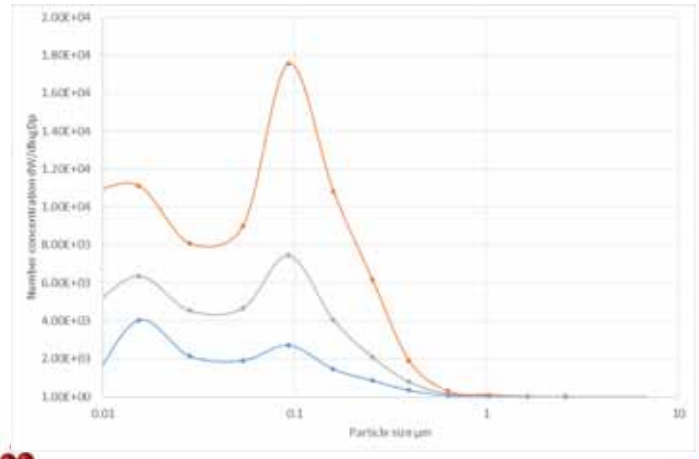
Mass closure



ELPI+ number concentration



ELPI+ number size distributions



Conclusions

- Similar PM mass results from measurement instruments with different operating principles
- Mass & number concentration followed activity in the mine
- PM from particles <0.5µm attributed to diesel exhaust while larger particles could be attributed to mineral dust
- Nucleation mode particle concentration lower and nucleation events less frequent than in typical ambient measurements
- Massive amount of data from measurements, much more analysis to be done

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Thank you!
Questions?