Water management and quality in mining areas – two case studies

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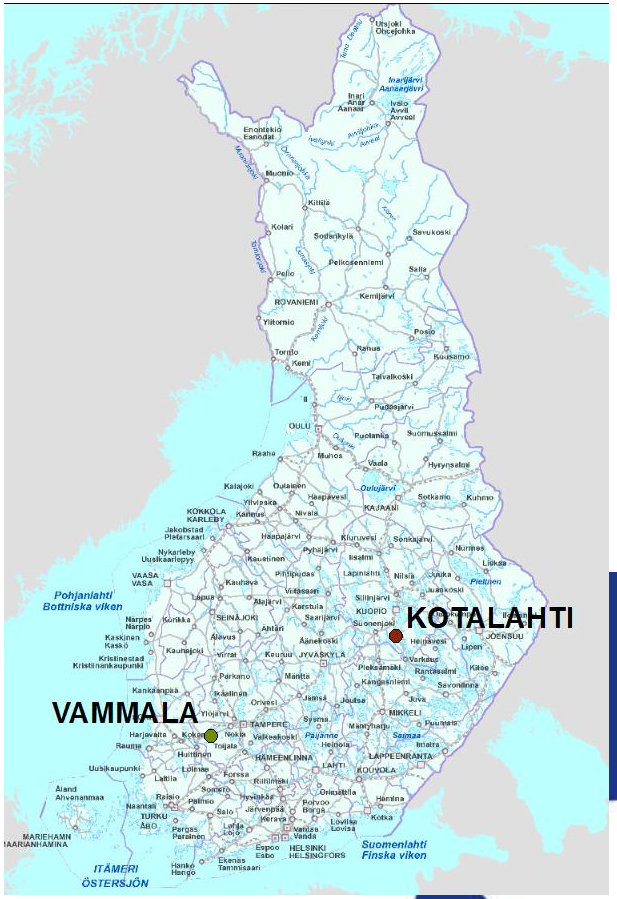
Two mine cases

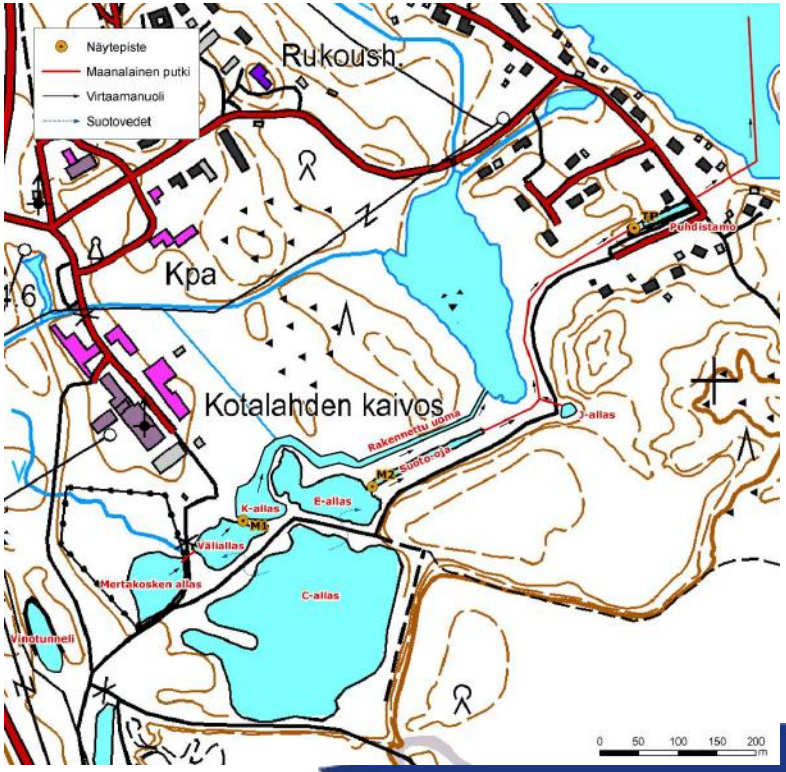
- Kotalahti, a closed Cu,Ni-mine
  - Operating time 1957-1987
  - Kotalahti intrusion was about 1,3 km long, 200 meters wide and 1 km deep.
  - Mine area is about 100 ha.
  - Located in Eastern Finland, community of Leppävirta
  - After care has been done since the mine was closed
  - Total water volume of the mine (including shafts) is estimated about 3 million m^3.
- Vammala's concentration plant



Kotalahti, aerial photo 2013

Kotalahti

- Lot of studies and test operatios of mine water management to obtain the environmental limiting values.
- In 2010: **a new direction of mine water** and construction of wetland
- Environmental permit set the limits to the discharging water from the mine site:
  - Suspended solids ≤10,0 mg/l
  - Fe ≤ 2,0 mg/l
  - Ni ≤1,0 mg/l
  - pH 6 -9
  - These limiting values should not exceeded.



In 2010: a new direction of mine water and **construction of wetland**

Kotalahti

- In 2011 **a new channel for cleaner water** was constructed
  - To cleaner water
  - Iron oxidation and precipitation to the bottom of the previous channel → Fe-load will diminished to the nearest water system Oravijoki

Kotalahti

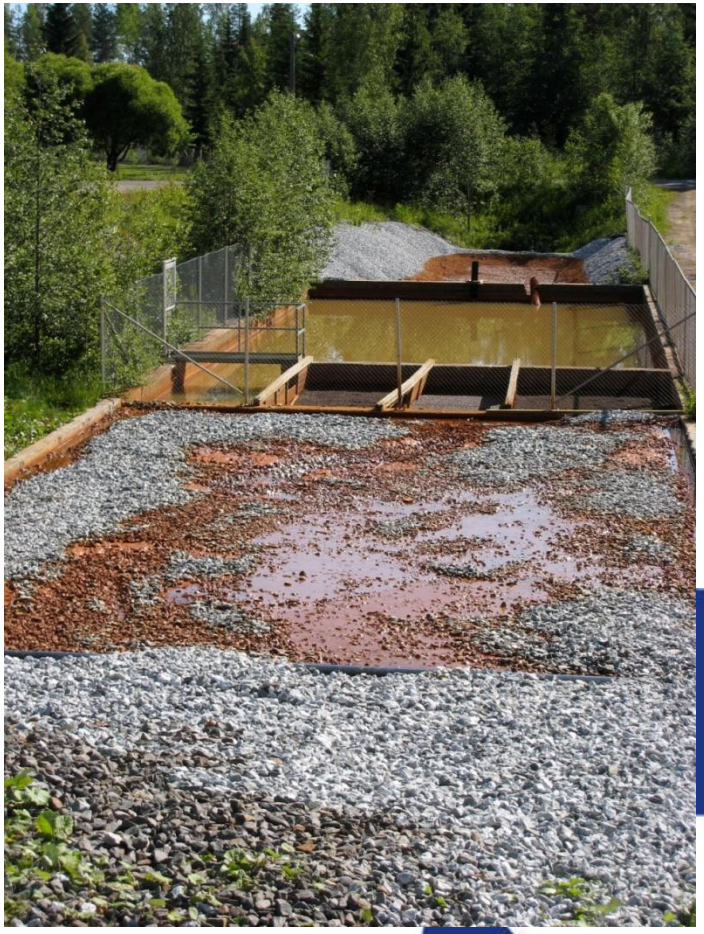
- In winter 2011-2012 testing an **oxidizing treatment in Mertakoski pond** to oxidize iron.
  - Didn’t work.

Kotalahti

- **Water treatment plant**
  - ca. 100 meter long and 10 meter wide
  - three different funtional parts:

  1) dry filter (crushed calcite product), which increase the pH (Ni).
  2) Slowing filter-part middle of the treatment plant to settling down the suspended solids (in the spring time the flow can be too high)
  3) Chrushed stone above and peat-layer under to precipitate iron.

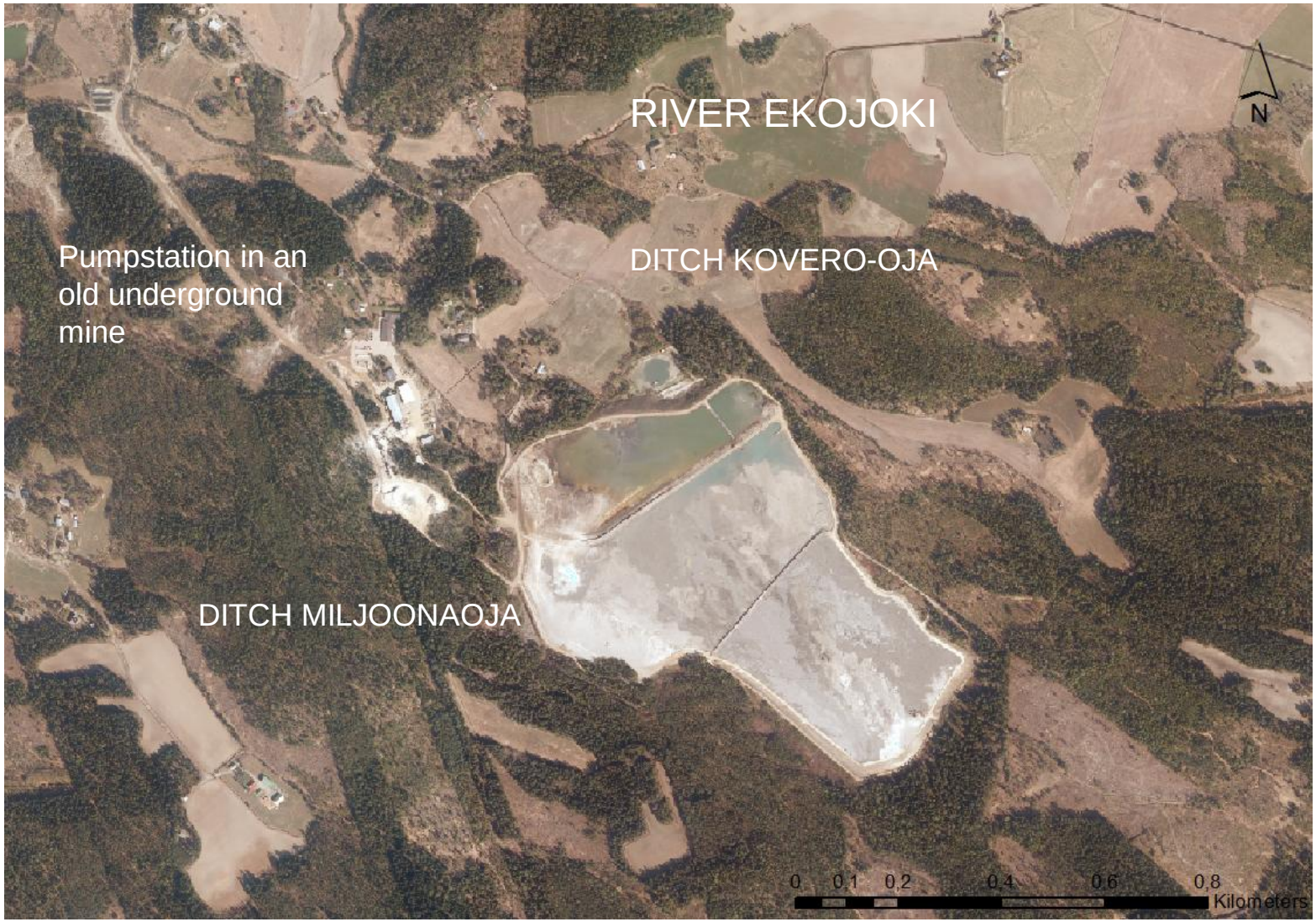
- All these actions helped the treatment plant to work properly
  - Iron precipitation get better
  - Water quality has reached the environmental limiting values
    - Fe ≤ 2,0 mg/l
    - Ni ≤1,0 mg/l (almost)
    - pH 6 -9



Vammala concentration plant and tailings area

- Located in the Sastamala region in southern Finland
  - Au-ore ca 200,000 tonnes/year
  - ca. 94 % is tailings material
  - Process need water about 1 million m^3/year
- Ni,Cu-Ore mining starts in1960's
- Ni,Cu-ore enrichment 1975-1995
- Au-ore enrichment 1994-2003 and from 2007
- Tailings area (in 2012)
  - Ca. 5,7 Mt tailings material from Ni-Cu-ore
  - Ca. 1,1 Mt tailings material from Au-ore enrichment
  - Average depth is 11 meter
    - Au-ore tailings material about 1,5-2 meter

Vammala – The concentration Plant, aerial photo 2011

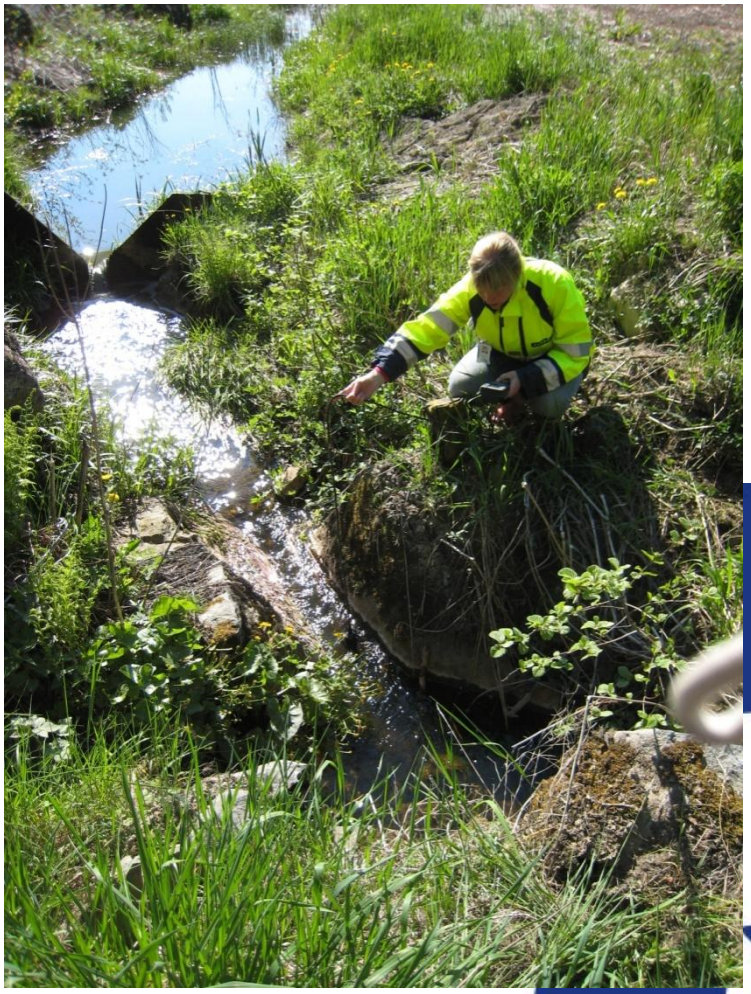


Vammala process plant – water circulation

- Process water from the plant
  - There is four different pump stations
    - Two in plant area
    - One in river Ekojoki
    - One in an old, underground mine
  - Water (to the process) is taken from the underground mine
  - From the process, water is pumped to the tailing area → clarification pond → clarified water goes back to the process via pumpstation in Ekojoki
- Drainage water from the plant area flows to the nearest ditch → pump station → tailings area
- Seepage water of tailings area, partly collect via pump station (when water level is high enough)→ back to the tailings area. Meanwhile water flows to the Kovero-oja

Vammala process plant – tailings environmental impact

- Concern of the nickel and sulfate load to the surrounding water system
  - → seepage water study
  - – water quality and impacts of the tailings area
- Seepage water study in 2012
  - – Dissolved and total element concentration
  - – pH, EC, redox, temperature, oxygen
  - – Water flow directions
  - – Wetlands around the tailings area
  - – Sediment study (elemental)



Some results of the seepage water study

- Wetland areas surrounded the tailings area and iron was mostly precipitated in wetlands sediments.
- Sediments elemental concentration were higher close to the tailings area than the natural surrounding area
  - Fe: 2- to 7-fold higher
  - Ni: 3- to 21-fold higher
  - S: 5- to11-fold higher

Some results of the seepage water study

- Seepage water flows two directions
- Elevated sulfate and nickel concentrations were seen in the nearest ditch Kovero-oja

  → and slighty elevated concentrations in Ekojoki
- Other elemental concentrations (Cu, Co, As) decrease or stayed at the natural level in downstream (Ekojoki)

Some results of the seepagewater study

- One of the main result was that the recycling of the mine water could be more efficiently.

- An environmental permit procedure pending in authorities (at regional State Administrative Agencies)

Thank you

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