

Small 110-year old mine in northern Sweden leaves disproportionately high metal impact on water quality

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Presentation is based on:

Fischer, S., Rosqvist, G., Chalov, S.R. and J. Jarsjö, 2020: Disproportionate Water Quality Impacts from the Century-Old Nautanen Copper Mines, Northern Sweden. Sustainability. <https://doi.org/10.3390/su12041394>

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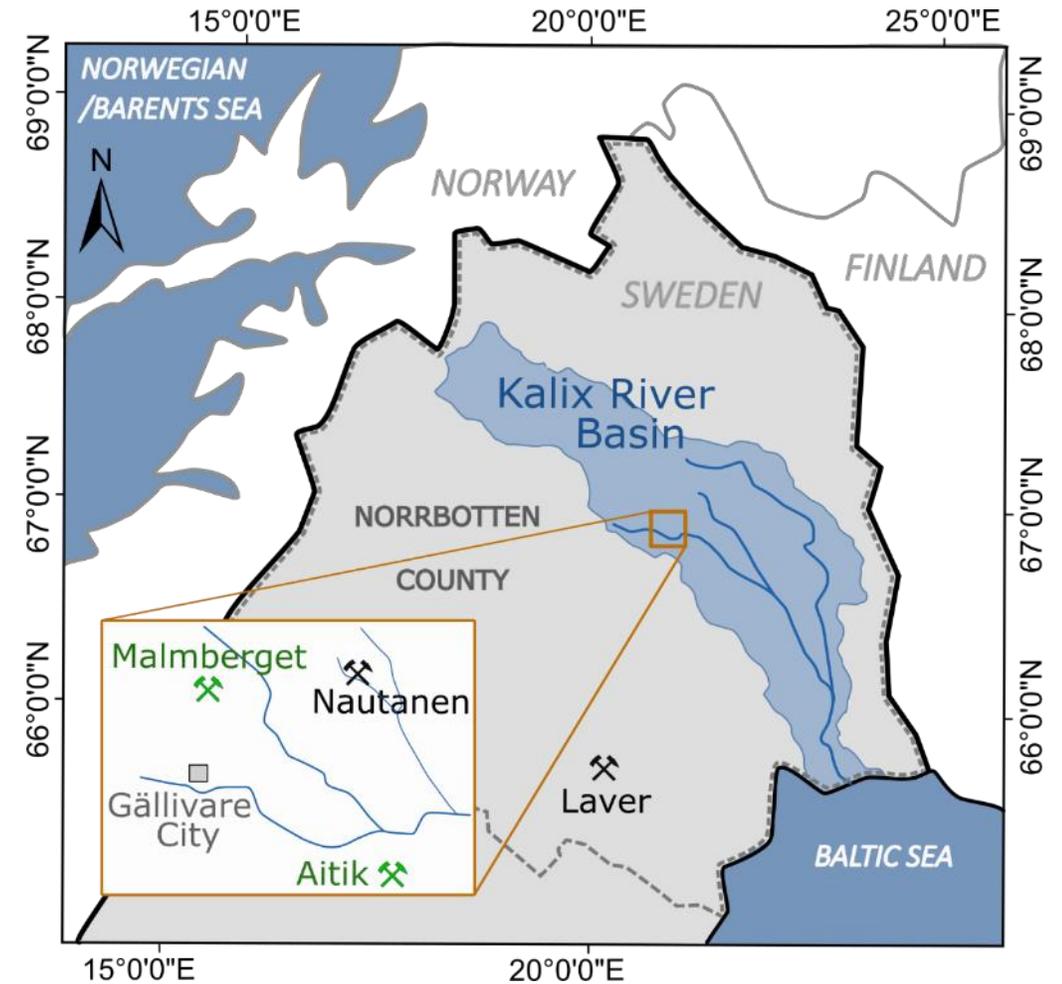
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SCOPE:

- Pollution from unmonitored abandoned mines is not prioritized
- Few studies in Arctic: long-term metal spreading processes not well known in colder climates
- Case study: Nautanen copper mine, northern Sweden
 - Active: 1902-1908
 - Undisturbed mine waste for 110 years



METHOD: Mass flow analysis

Long-term average mass flows, $\overline{MF}_{L,j}$ (kg/yr)
25-year period (1993-2017 – only period w. data)

$$\overline{MF}_{L,j} = \bar{C}_{L,j} \bar{Q}_{L,j}$$

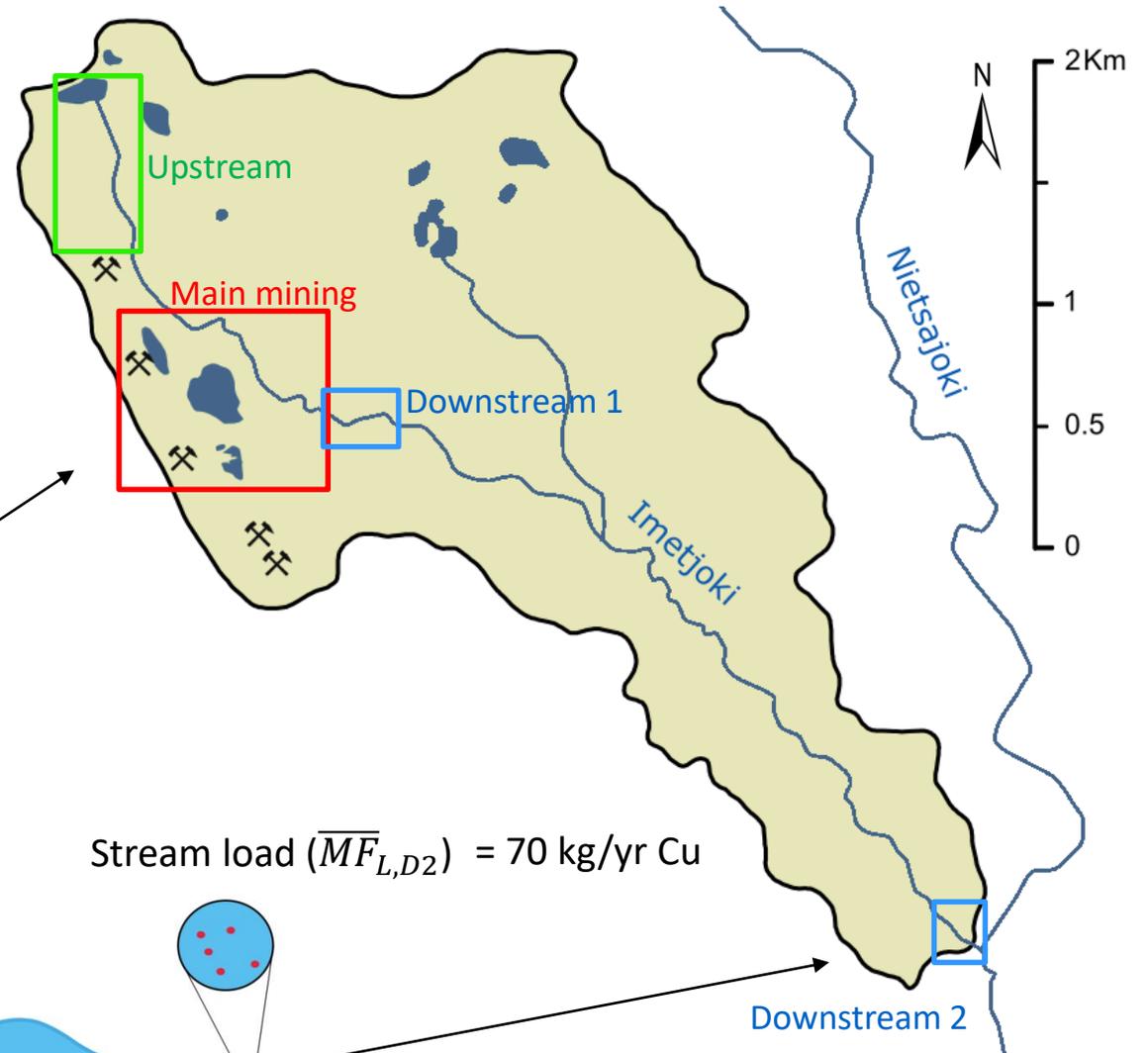
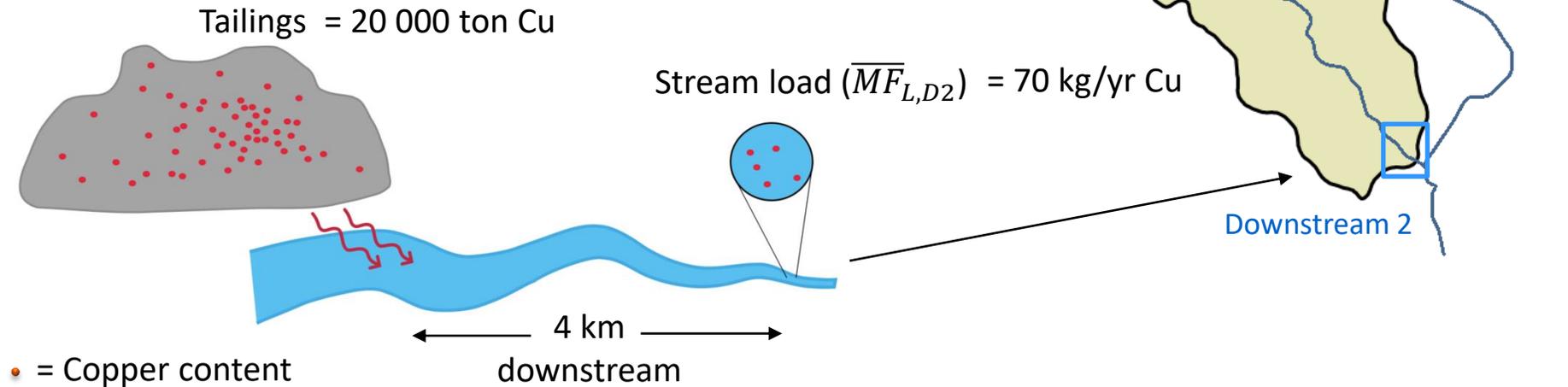
$\bar{C}_{L,j}$ = long-term average concentration
 $\bar{Q}_{L,j}$ = long-term average discharge

“Stream load-to-tailings” ratio:

Ratio calculation:

0.07 : 20000

1 : 10⁵



Feedback from EGU live-chat?

- Nautanen is compared to two other abandoned copper mines with similar characteristics:
 - Mostly un-remediated
 - Abandoned since at least 70 years
 - Arctic climate conditions
- **Question: Can different mining sites be compared with such a simple ratio, or are local conditions too site specific (e.g. abundance/availability of the ore in host rock, weathering potential of the waste, hydrological flow paths etc.)?**
- Such a comparison could enable estimations of cumulative effects of abandoned mines at the landscape scale.

Abandoned mine	Stream load	Tailings	Ratio
Nautanen	70 kg/yr	20 000 ton	1:10 ⁵
Laver*	70 kg/yr	1.2 million ton	1:10 ⁷
Sherritt-Gordon**	460 kg/yr	7.4 million ton	1:10 ⁷

Disproportionately high metal leakage for a small site

*Alakangas, L.; Öhlander, B.; Lundberg, A. Estimation of temporal changes in oxidation rates of sulphides in copper mine tailings at Laver, Northern Sweden. *Sci. Total Environ.* 2010, 408, 1386–1392.

**Moncur, M.C.; Ptacek, C.J.; Lindsay, M.B.J.; Blowes, D.W.; Jambor, J.L. Long-term mineralogical and geochemical evolution of sulfide mine tailings under a shallow water cover. *Appl. Geochem.* 2015, 57, 178–193.