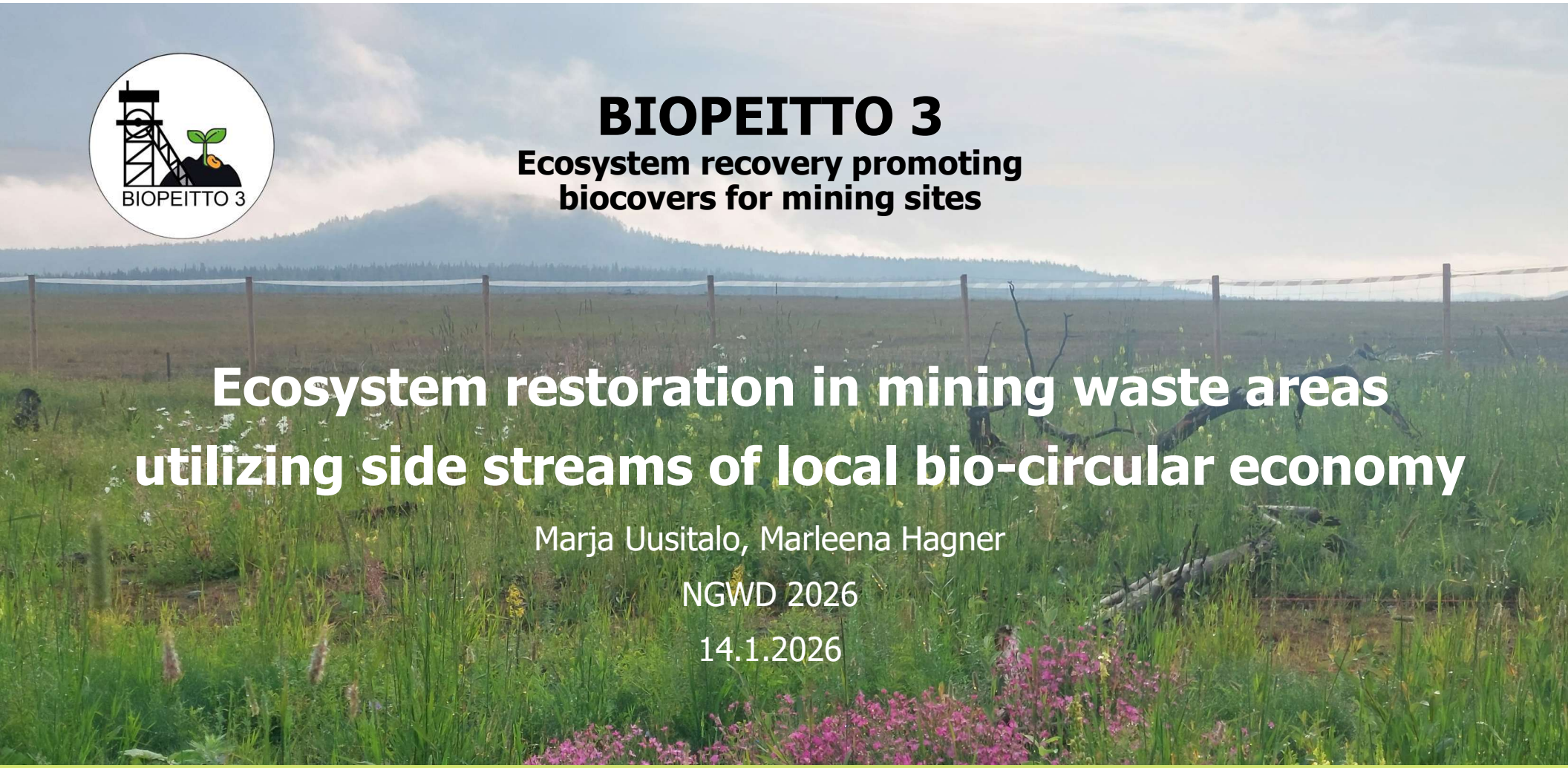

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Ecosystem recovery promoting biocovers for mining sites

Ecosystem restoration in mining waste areas utilizing side streams of local bio-circular economy

Marja Uusitalo, Marleena Hagner

NGWD 2026

14.1.2026

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Content

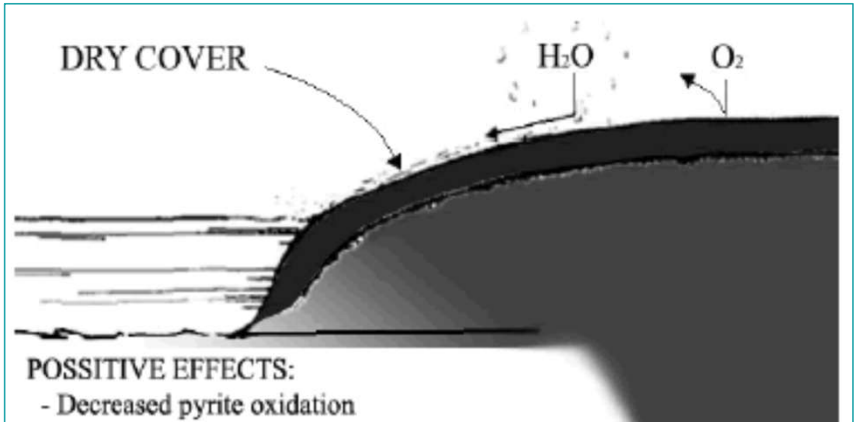

Figure 1. Dry cover preventing the penetration of oxygen and water.
Source: Ledin and Pedersen, 1996 [27].

- Why ”biocovers”?
- What has circular economy to do with it?
- What was learnt?
- Practical solutions

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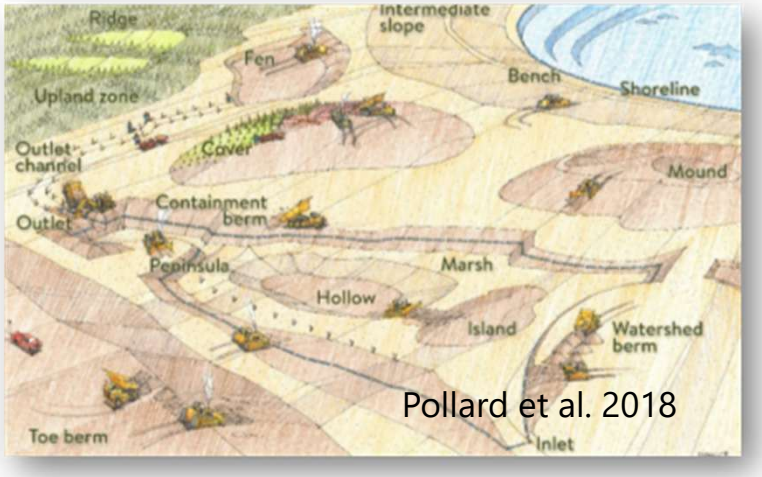
Dry covers

- In the Arctic conditions, revegetation of waste rocks are challenging
  - Potentially toxic elements
  - Nutrient-poor till
  - Cool temperatures and short growing period

→ Need for organic materials and scientific knowledge



Pollard et al. 2018

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Recycled waste materials

- Increasing amounts of organic by-products and wastes
- Composted sewage sludge & biochar
- Feasibility of recyclable waste materials for the cover systems?
    - Soil forming process ?
    - Decrease metal bioavailability ?
    - **Revegetation success ?**

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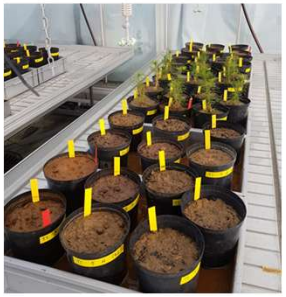
Projects

Time & Scale



Biocover
Use of biochar in mineral waste cover materials (2017-2020)

Biocover 2
New regional operating models and biocoverage solutions promoting the circular economy in the aftercare of mines (2021-2023)

Biocover 3
Biocover solutions to promote ecosystem recovery in post-mining (2024-2026)

Biocover Kainuu
(2024-2026)

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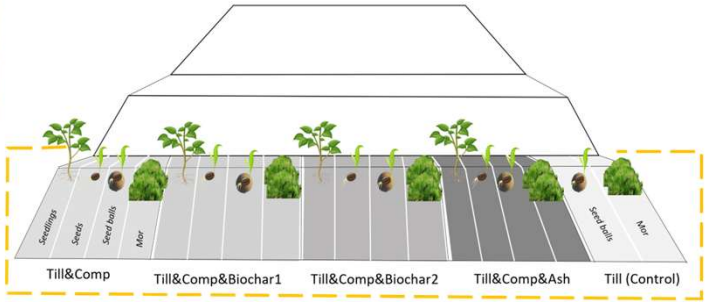
Vegetation studies

A. Tailings in Rautuvaara, Kolari and Pahtavaara, Sodankylä

B. Waste rock disposal areas in Kevitsa, Sodankylä



Establishment methods
- Pot-grown seedlings
- Seeds
- Meadow clippings
- Forest floor material
- Transplanted tree seedlings

Factors
- Survival
- Germination
- Growth
- Spread

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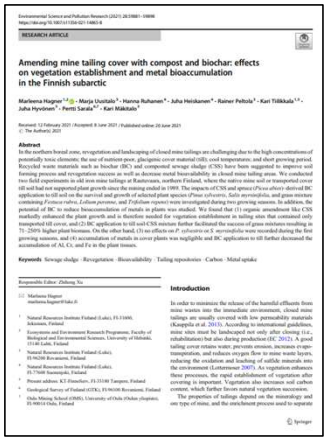
Effect of different biocover solutios on plant growth

Rautuvaara tailing

+ 20—200%

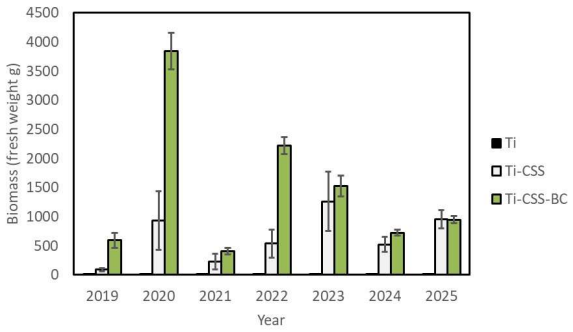
Addition of recyclable biochar, compost and fibre clay to the growth medium layer for the cover system of mine tailings: a bioassay in a greenhouse



Amending mine tailing cover with compost and biochar: effects on vegetation establishment and metal bioaccumulation in the Finnish subarctic

Till + compost + biochar

Till + compost



https://doi.org/10.1007/s12665-020-09154-5
https://doi.org/10.1007/s11356-021-14865-8

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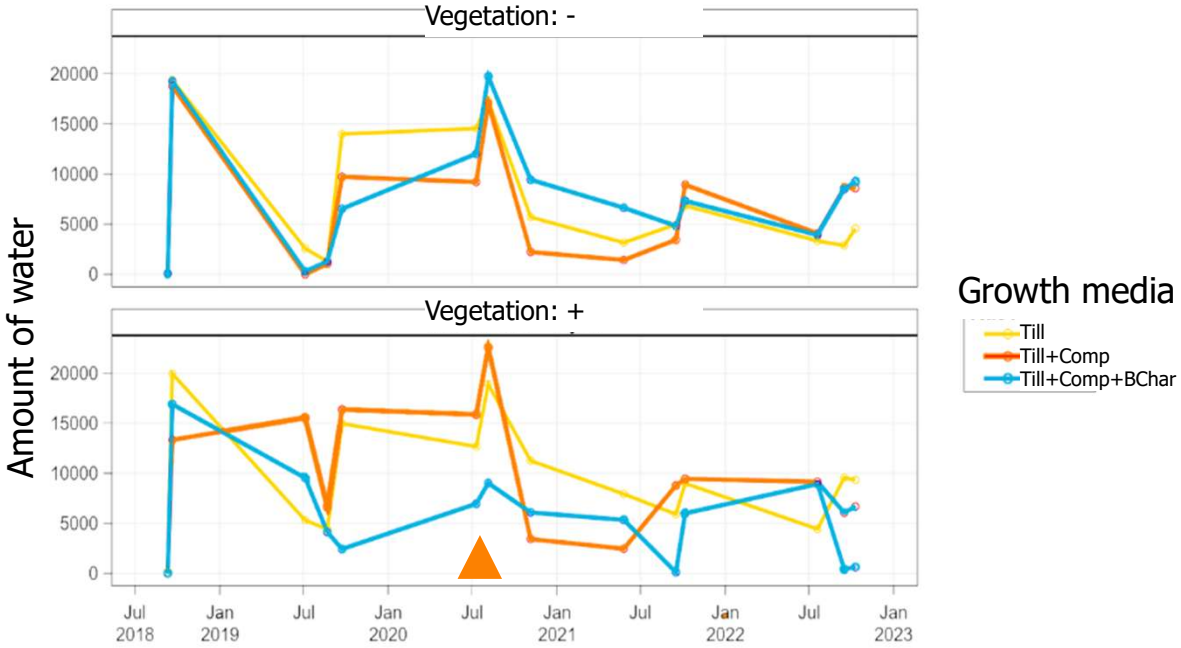
Effect on water quantity



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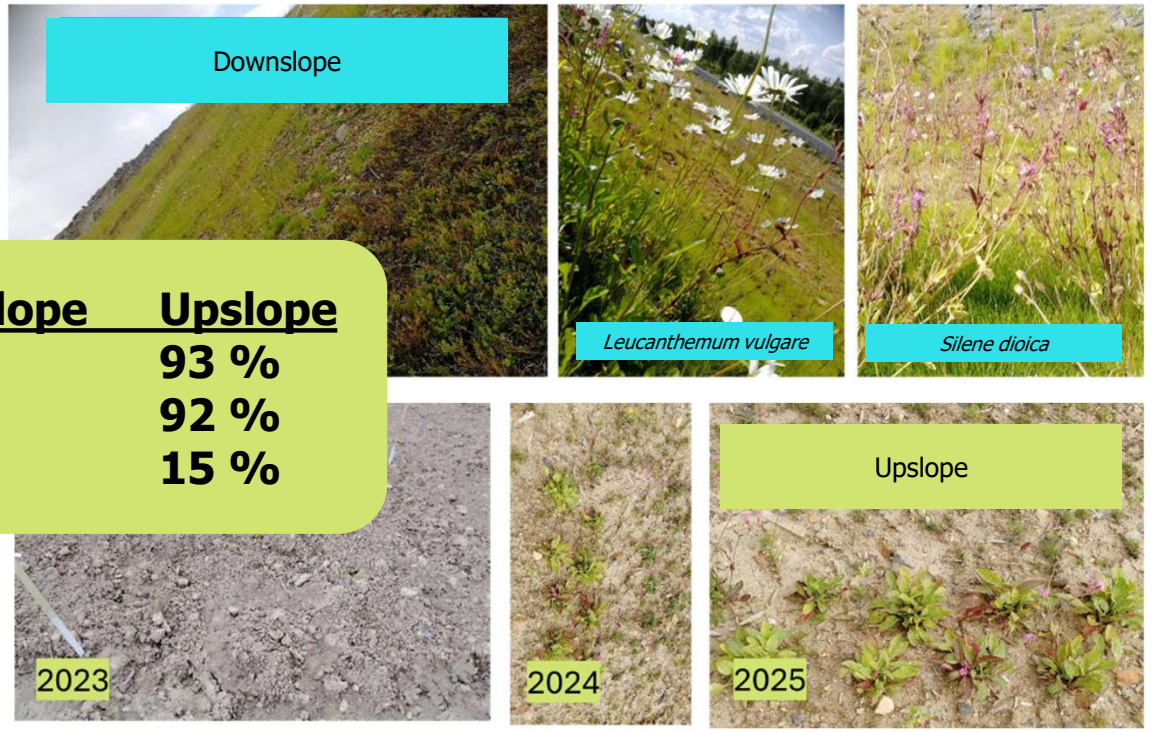
Species survival

Kevitsa rock disposal area

	Downslope	Upslope
Silene dioica	**97 %**	**93 %**
Potentilla crantzii	**100 %**	**92 %**
Campanula rotundifolia	**10 %**	**15 %**



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Number of species

Kevitsa rock disposal area

	2024	2025
Clippings	12	25
Seeds	5	3


Dianthus superbus


Veronica longifolia

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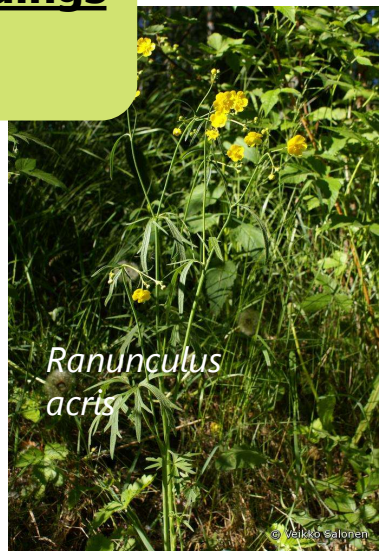
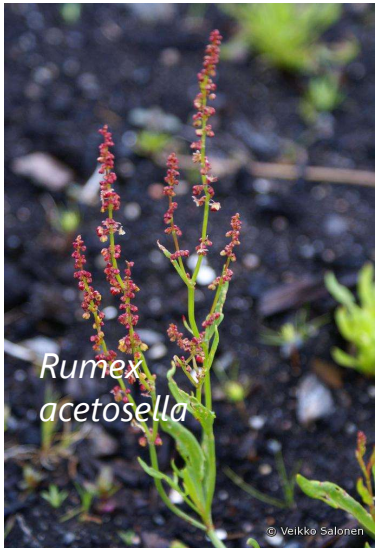
Number of species

Pahtavaara tailing

Clippings	Surroundings
12	7





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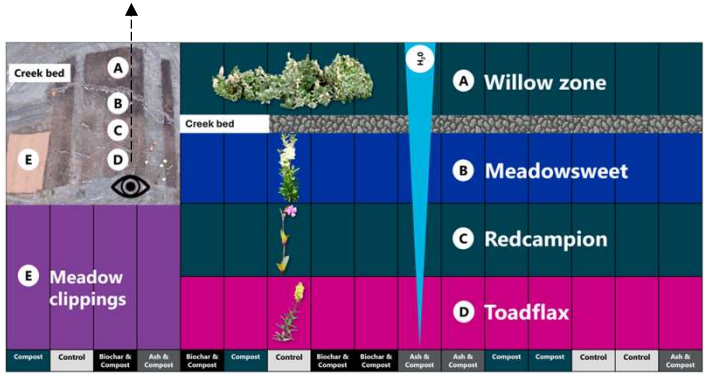
Geomorfology & microtopography



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Biodiversity

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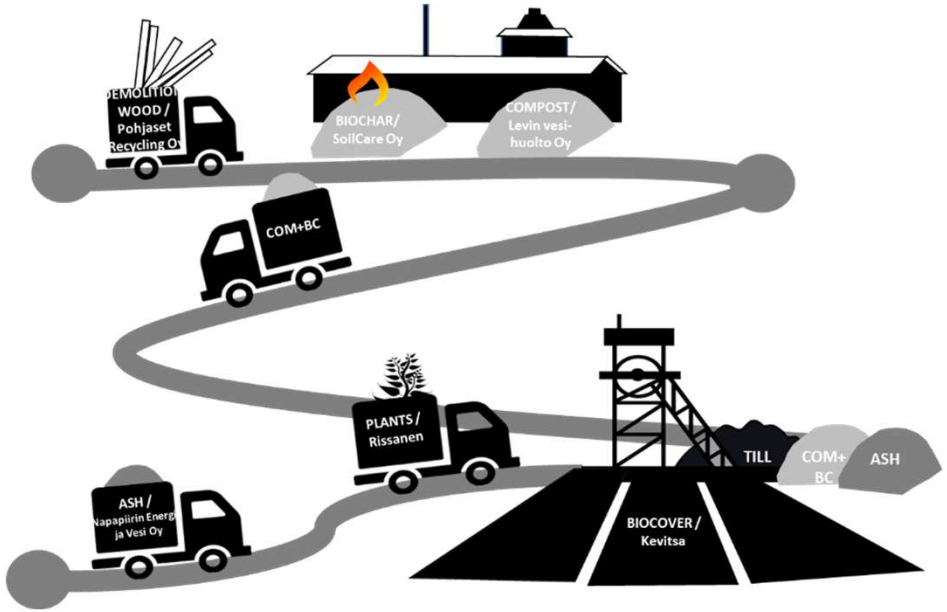
The role of regional circular bioeconomy



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Thank you

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