



## Metal and organic matter dynamics in permafrost environments

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## "Metal and organic matter dynamics in permafrost environments"

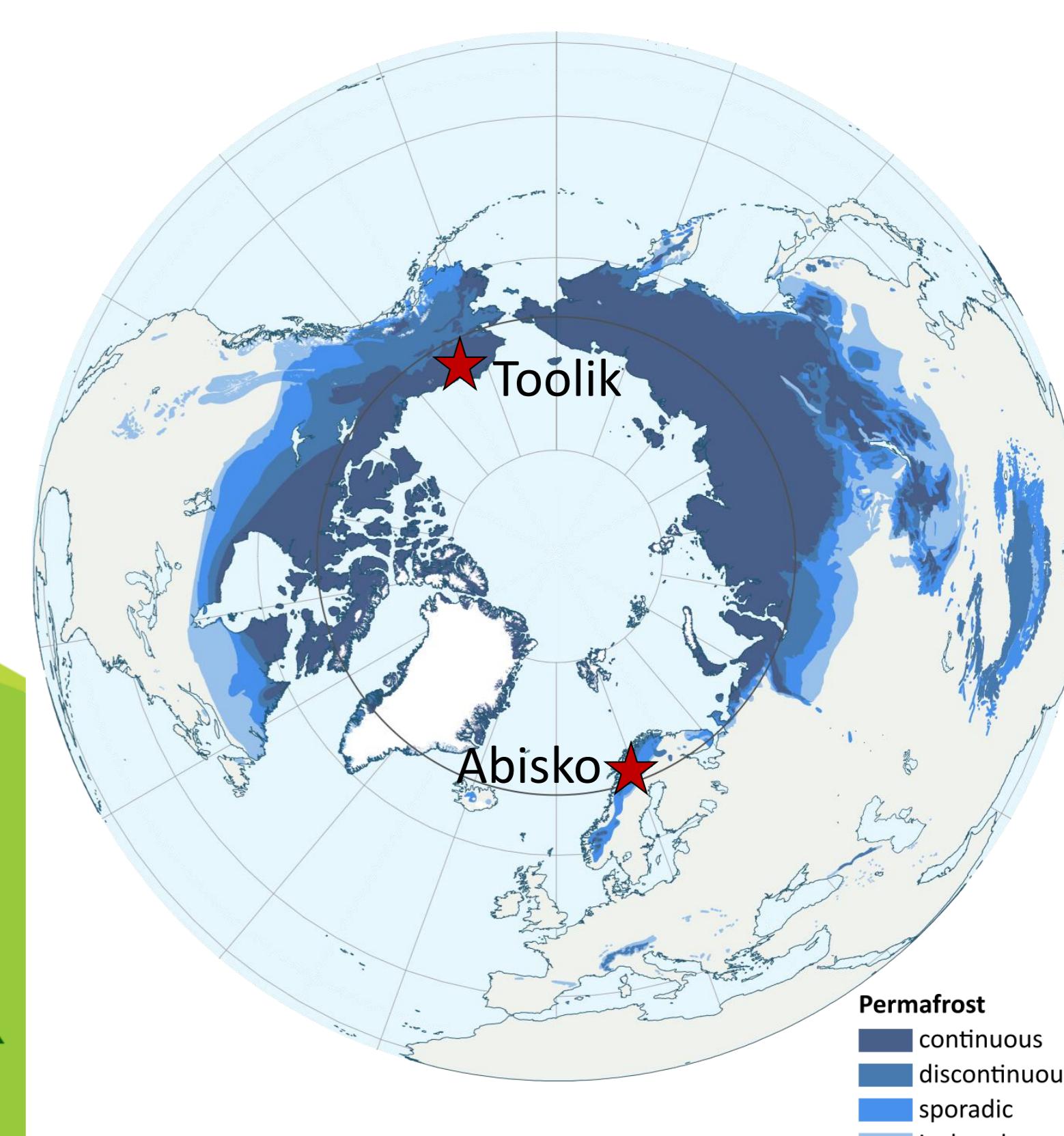
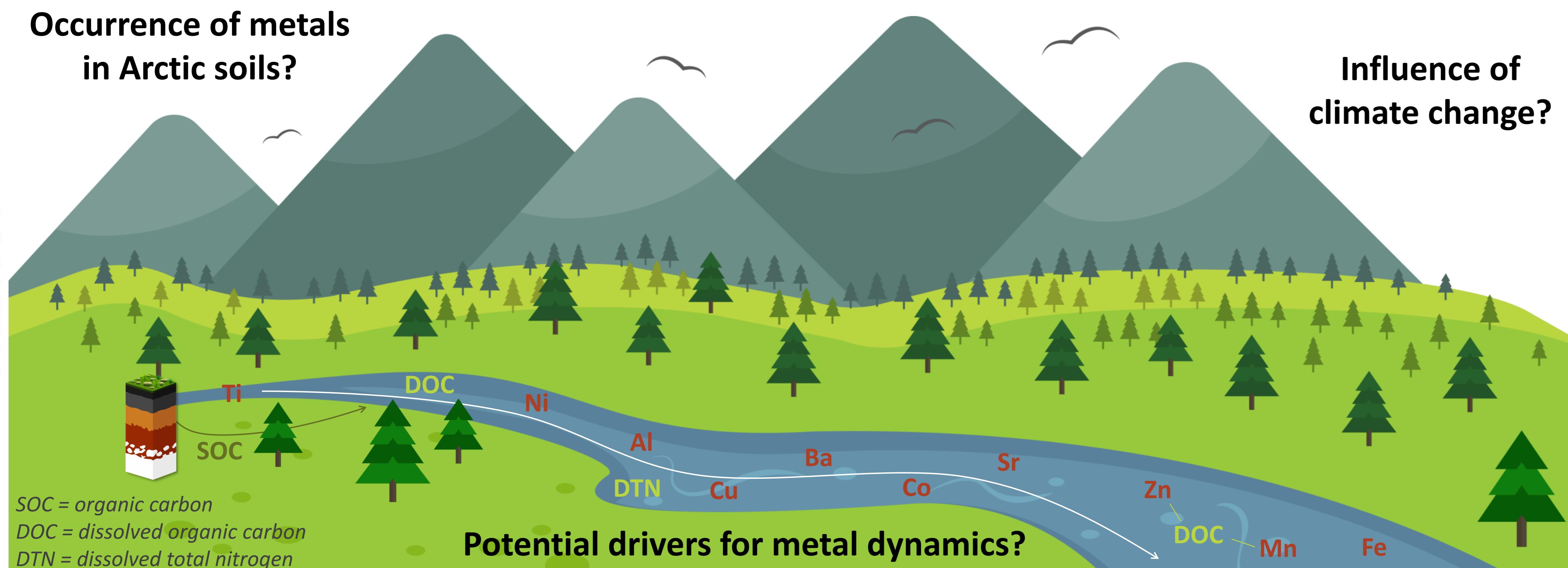
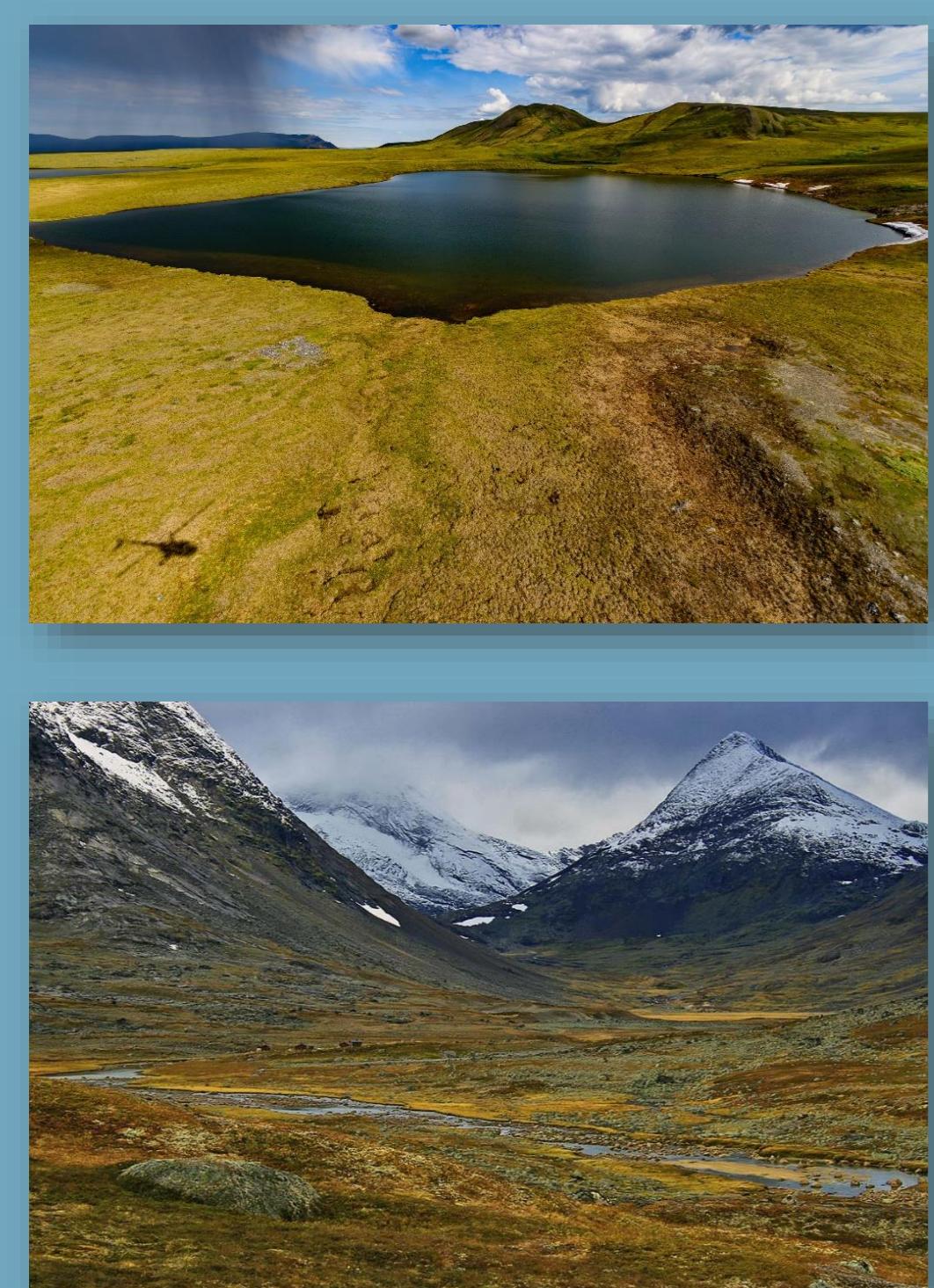
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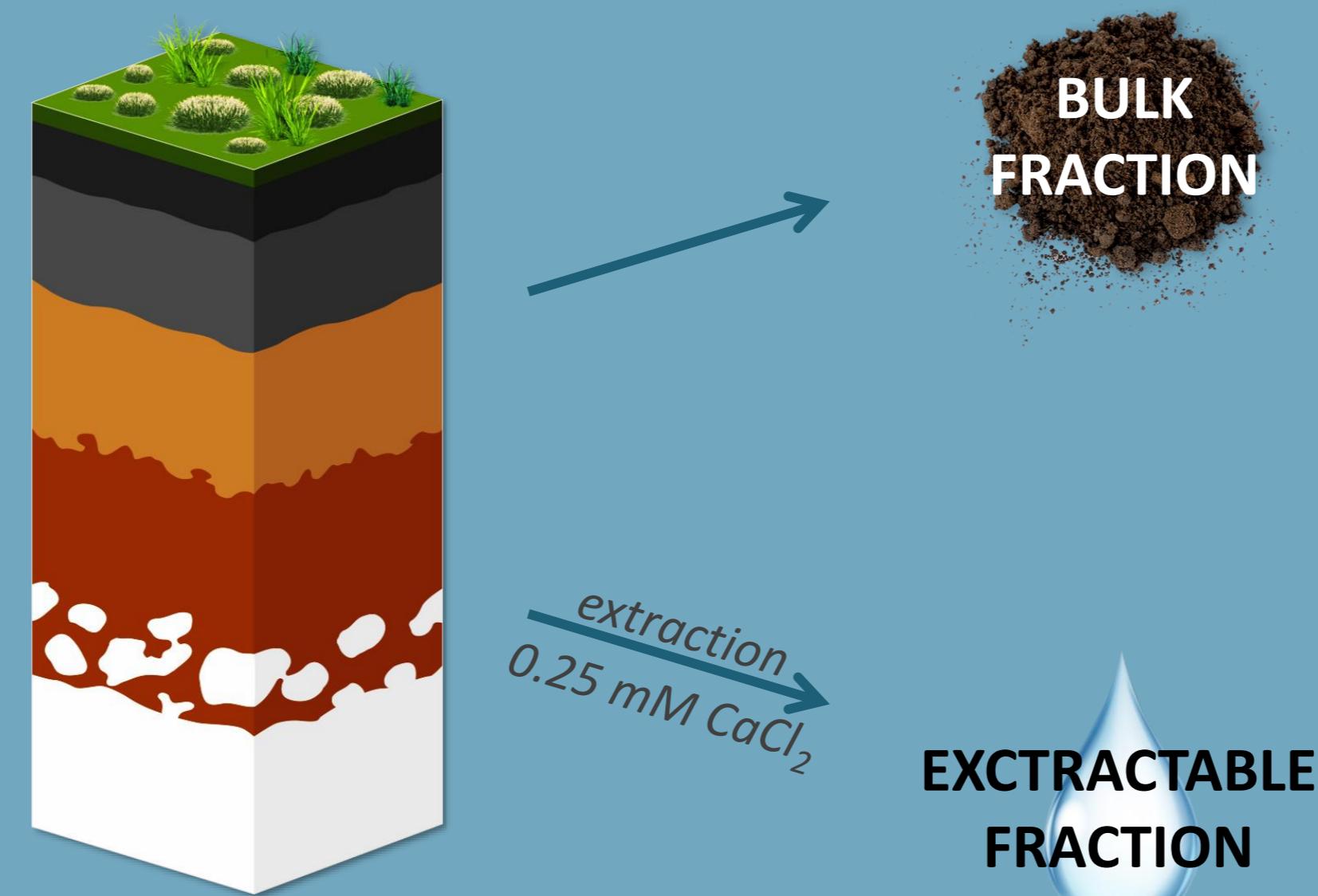
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Y. Agnan<sup>1</sup>, M.A. Alexis<sup>2</sup>, R. Courault<sup>3</sup>, M. Cohen<sup>3</sup>, T. Zanardo<sup>2</sup>, M. Sauvage<sup>2</sup>, A. Kohli<sup>2</sup>, L. Pinta<sup>2</sup>, M. Castrec-Rouelle<sup>2</sup><sup>1</sup>Earth and Life Institute, Université catholique de Louvain, B-1348 Louvain-la-Neuve, Belgium<sup>2</sup>Sorbonne Université, CNRS, EPHE, UMR METIS, F-75252, Paris, France<sup>3</sup>Sorbonne Université, CNRS, FRE ENeC, F-75006 Paris, FranceCONTEXT  
Occurrence of metals  
in Arctic soils?MATERIALS & METHODS  
Comparison of two study areas

Toolik (AK, USA)  
-8 °C  
tundra ecosystem  
continuous permafrost

Abisko (Sweden)  
-0.8 °C  
tundra and taiga ecosystems  
discontinuous permafrost

## Sampling and sample preparation



## Chemical analysis

→ Metals  
XRF / ICP-OES / ICP-MS

→ Organic matter  
EA (C and N)  
<sup>13</sup>C NMR

→ Metals  
ICP-OES / ICP-MS

→ Organic matter (DOC and DTN)  
DOC analyzer

→ pH<sub>CaCl2</sub>

RESULTS & DISCUSSIONS  
BULK FRACTION

- Mineral soil horizons show higher metal concentrations than organic ones. Differences between Abisko and Toolik in mineral soil horizons result from distinct lithologies (Fig. 1).
- Concentrations do not show the same patterns between the two study areas in both horizons, indicating various inputs and dynamics of metals.

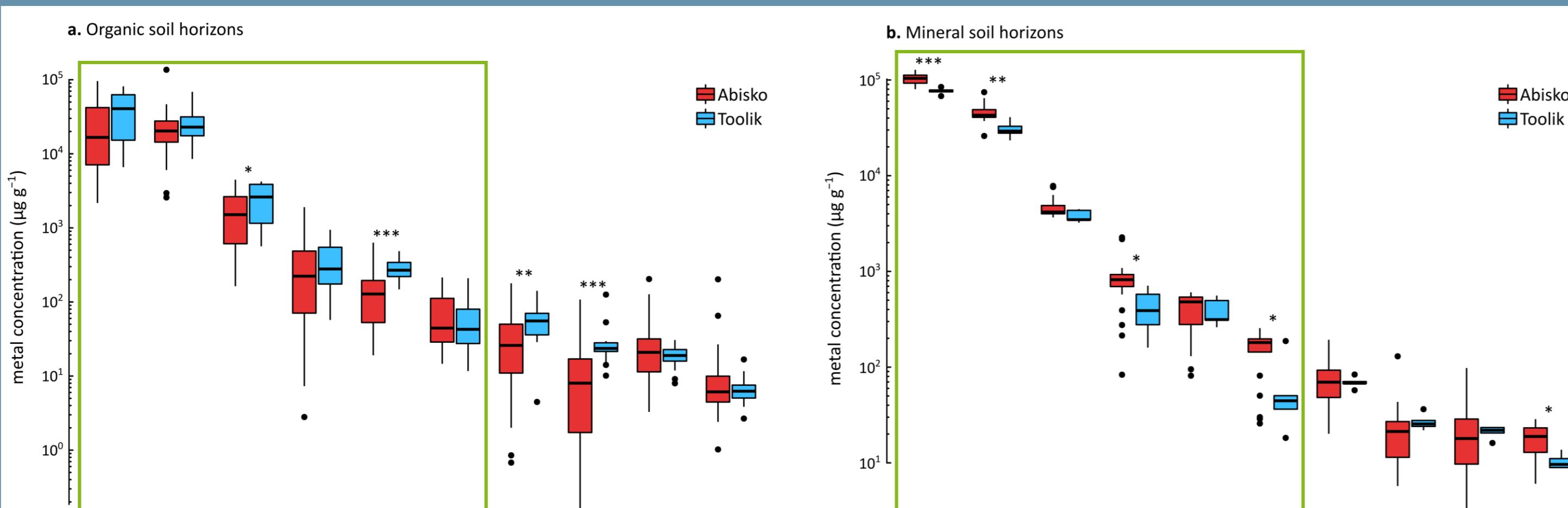


Fig. 1. Metal concentrations in organic (a) and mineral (b) soil horizons.  
\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001.

## EXTRACTABLE FRACTION

- Extractability of metals ranged from <0.01 to >10% of soil total metal concentrations according to the considered soil horizon and metal (Fig. 2): extractability is higher in the organic soil horizons.
- Differences between Abisko and Toolik appeared for aluminum, titanium, and barium, indicating different transfer processes involved.

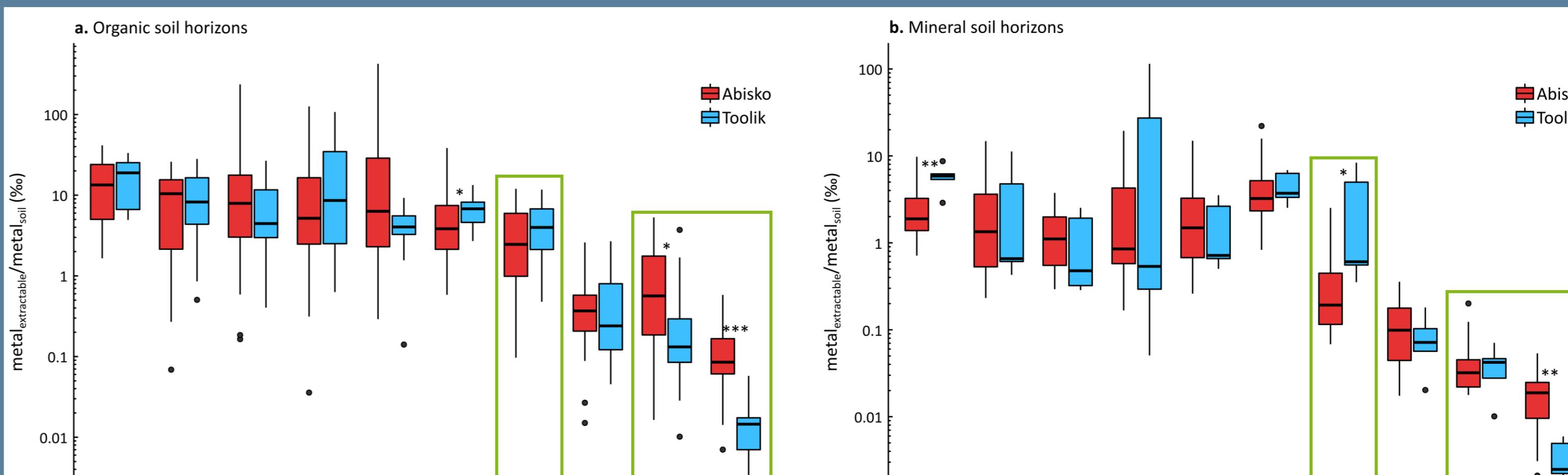


Fig. 2. Ratios between extractable and soil concentrations for each metal in organic (a) and mineral (b) soil horizons. \*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001.

## ENVIRONMENTAL CONTROL

- DOC production is related to SOC quality based on distinct decomposition degrees (Fig. 3a) and likely on different decomposition processes (Fig. 3b).
- As illustrated for aluminum and titanium, metal extractability is directly related to SOC extractability (Fig. 4).
- Metal extractability is also related to either soil pH (aluminum) or study area characteristics (titanium) such as climate or permafrost conditions.

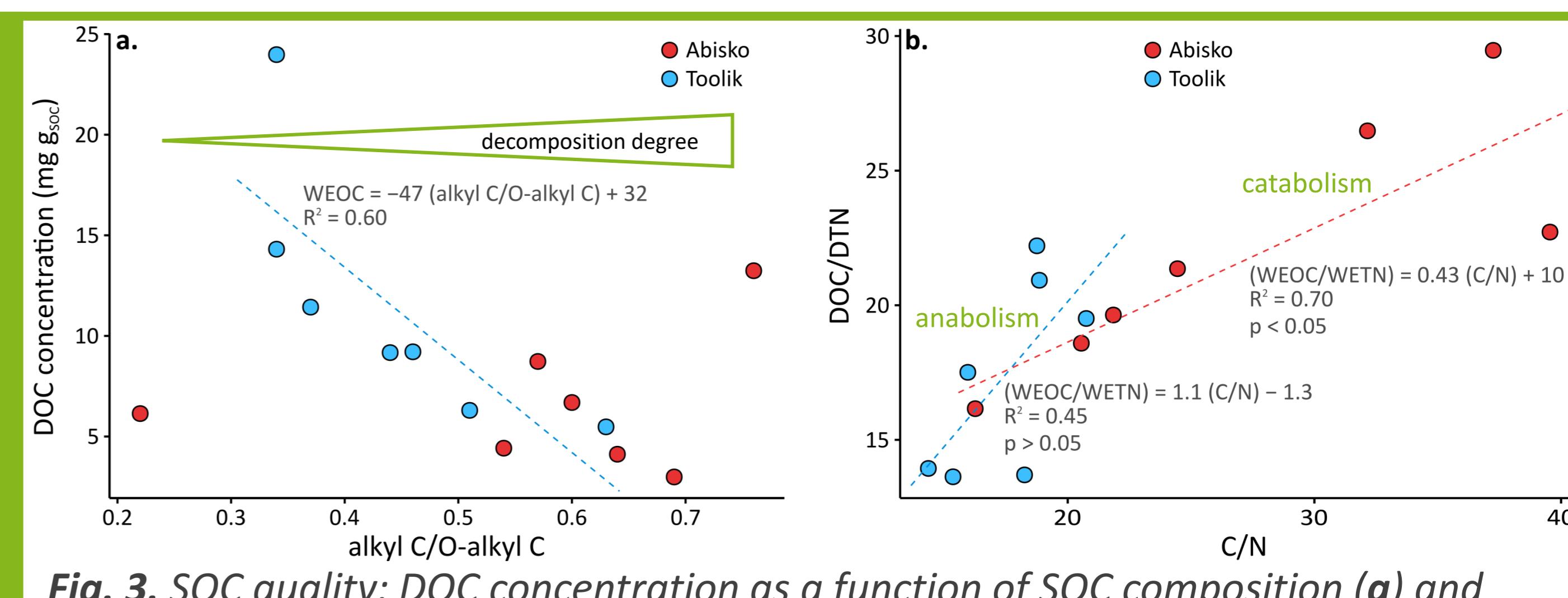
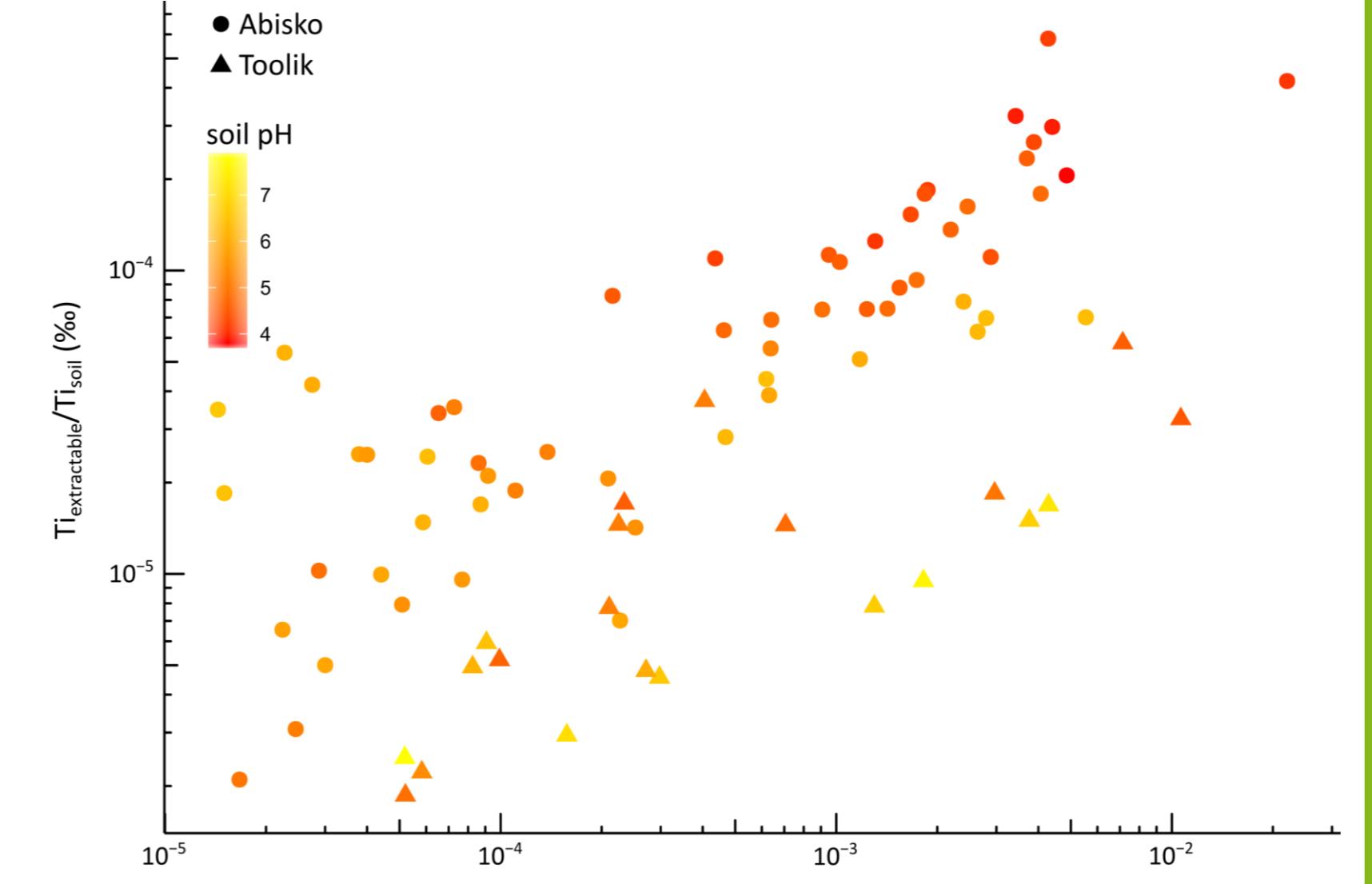
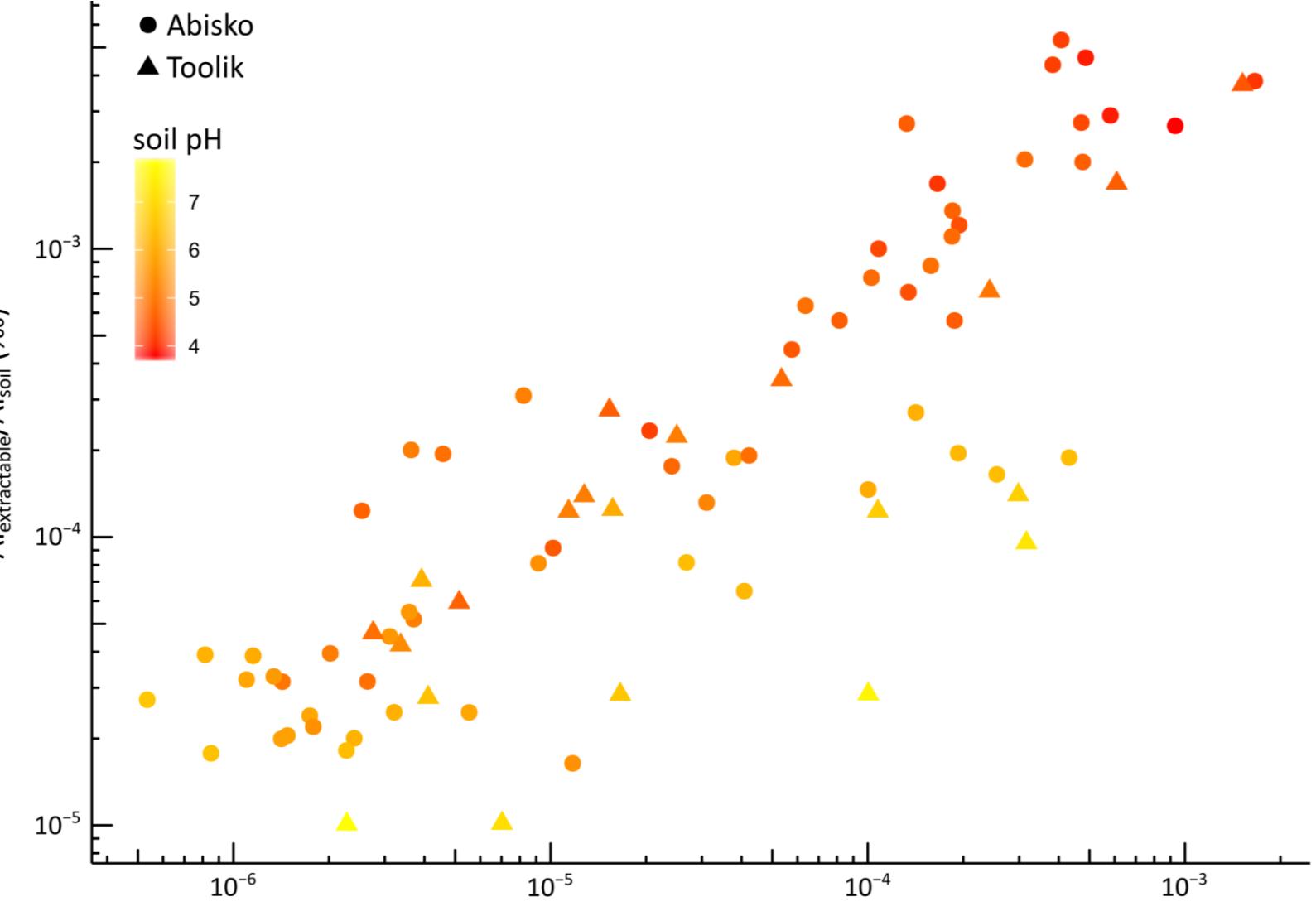


Fig. 3. SOC quality: DOC concentration as a function of SOC composition (a) and DOC/DTN as a function of C/N (b).

Fig. 4. Aluminum and titanium extractability as a function of DOC quantity according to soil pH<sub>CaCl2</sub> (color scale) and study area (shapes).



## ACKNOWLEDGEMENTS

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