

Hokkaido University
Graduate School of Environmental
Science
Division of Earth System Science



HOKKAIDO
UNIVERSITY



Achievement Report of RJE3 Program

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03.02.2016

Presentation plan:

1) Mini research: «Forest environment using C isotope ratios of plant»

Purposes: To estimate environmental condition in the Larch and Pine forests by using stable carbon isotope ratios in plants.

2) Presentation in isotope seminar : «Siberian larch forests and the ion content of thaw lakes form a geochemically functional entity»

Nature Communications 2013

Authors: Ulrike Herzschuh, Luidmila A. Pestryakova, Larissa A. Savelieva, Liv Heinecke, Thomas Boöhmer, Boris K. Biskaborn, Andrei Andreev, Arne Ramisch, Avery L.C. Shinneman & H. John B. Birks

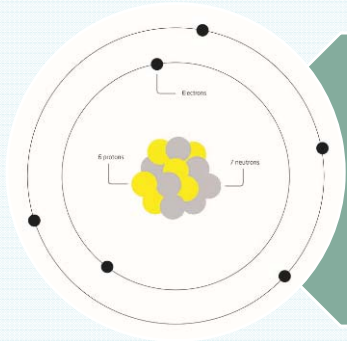
Mini research: «Forest environment using C isotope ratios of plant»



There are two forest types:
Larch forest and Pine forest



Species diversity in the larch forest more than a pine, there are such species as:
Arctous erythrocarpa, Linnaea borealis,
Pyrola rotundifolia, Rosa acicularis

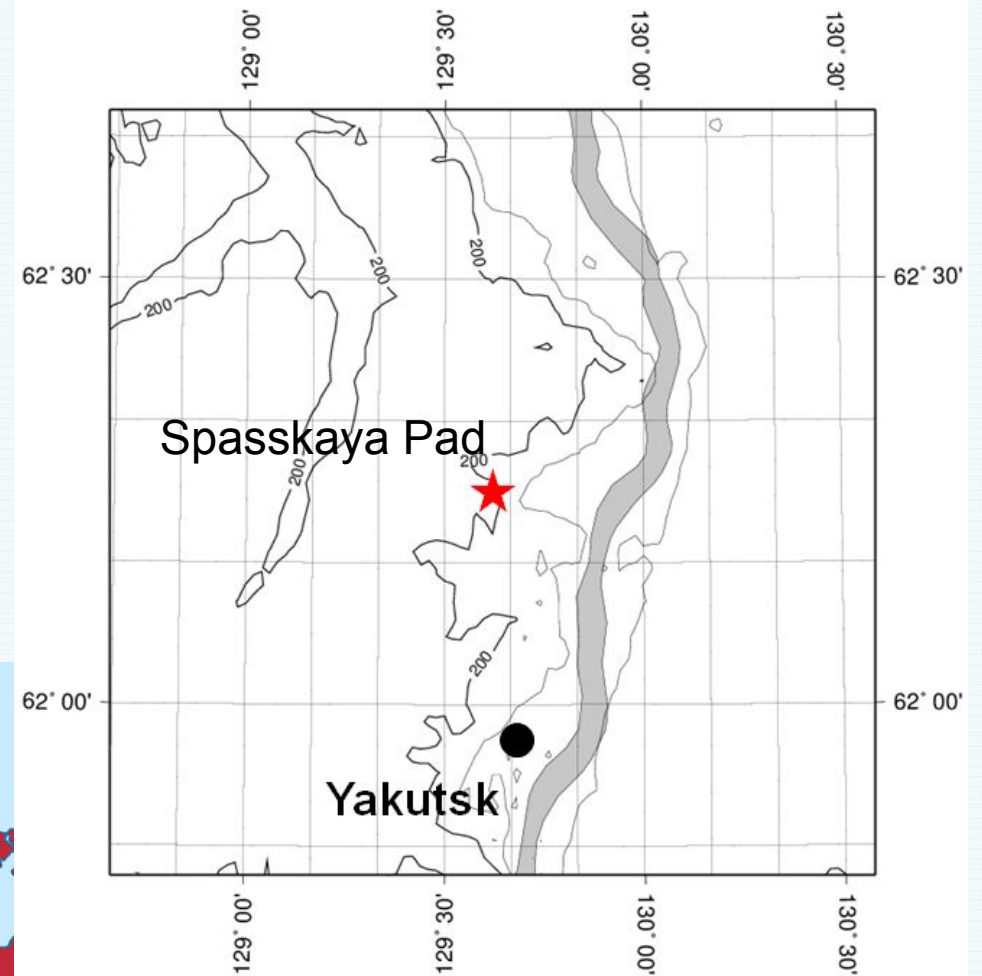


Carbon isotope ratios of plant may become indicators of the environmental condition

Purposes: To estimate environmental condition in the Larch and Pine forests by using stable carbon isotope ratios in plants.
 $\delta^{13}\text{C}$ ($^{13}\text{C}/^{12}\text{C}$)

The location of the study area

Plant samples at Spasskaya Pad in Eastern Siberia, the Republic of Sakha (Yakutia)

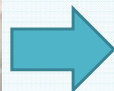


Method

Preparation of samples:



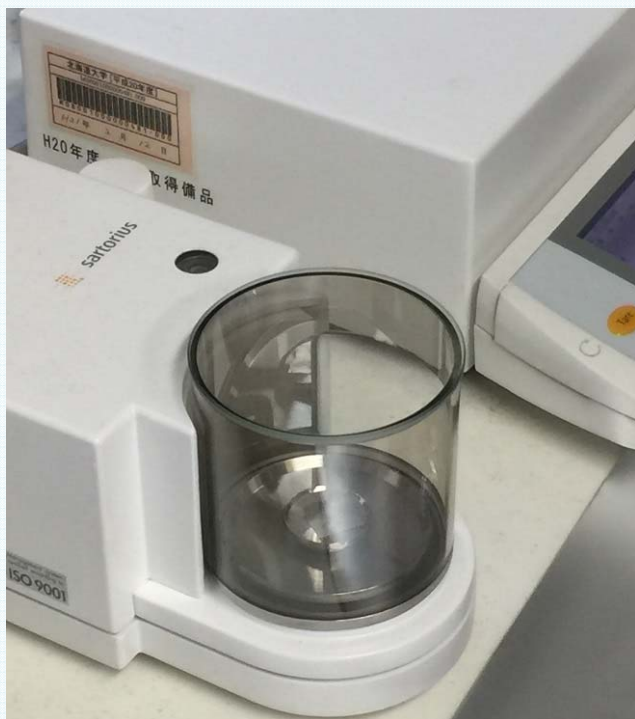
Dry leaves



Milling of dry leaves with Liquid nitrogen

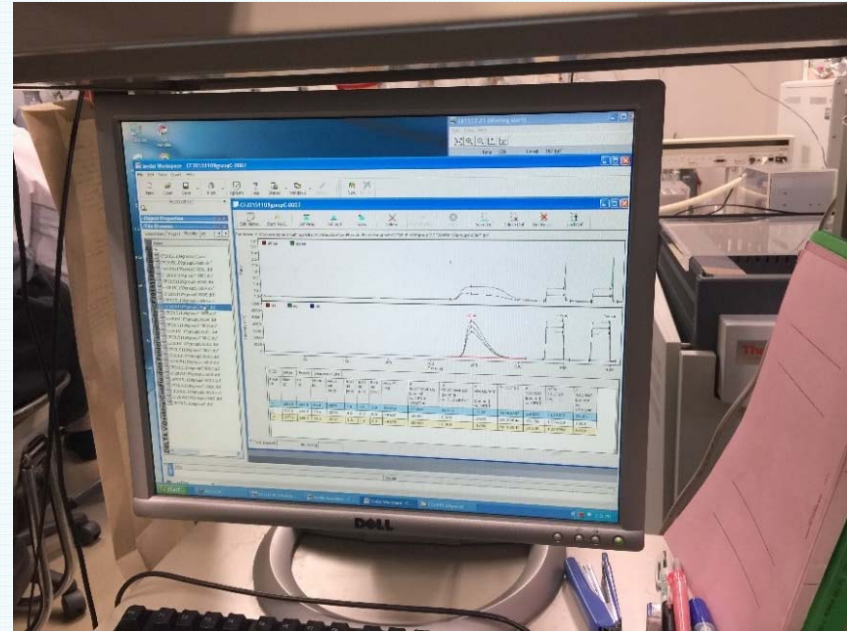


Putting samples in capsules



Weigh the samples

Analyze the samples:



Process the data

Calculate C and N%



Calculate C and N
amount in sample



EA regression line for
standard



Calculate the average
of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ for
standard



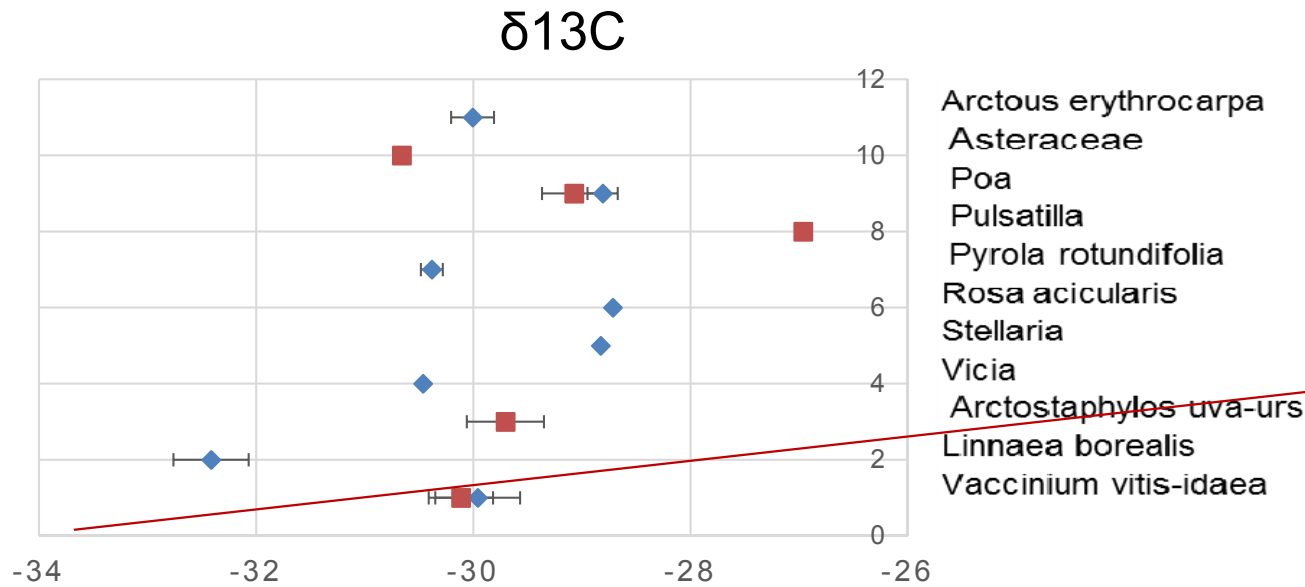
Calculate correction
value



Calculate corrected
value $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$
of the samples

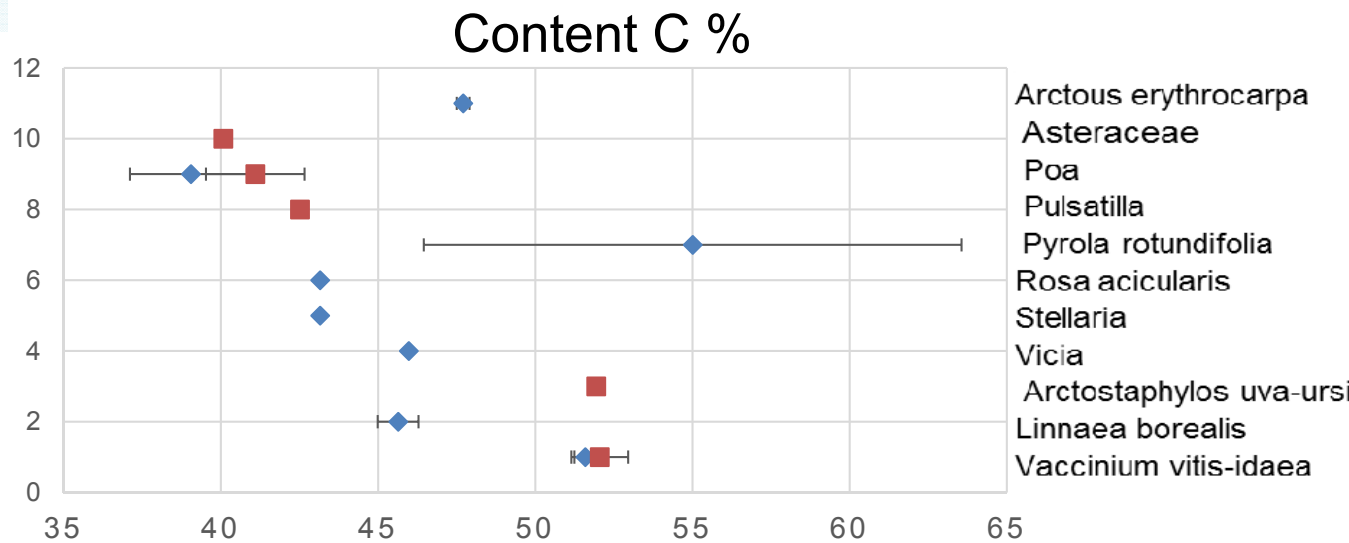
Results

The average $\delta^{13}\text{C}$ in plants Pine and Larch forests



to estimate condition for 1 year

$\delta^{13}\text{C}$ reflect condition for not only 1 year

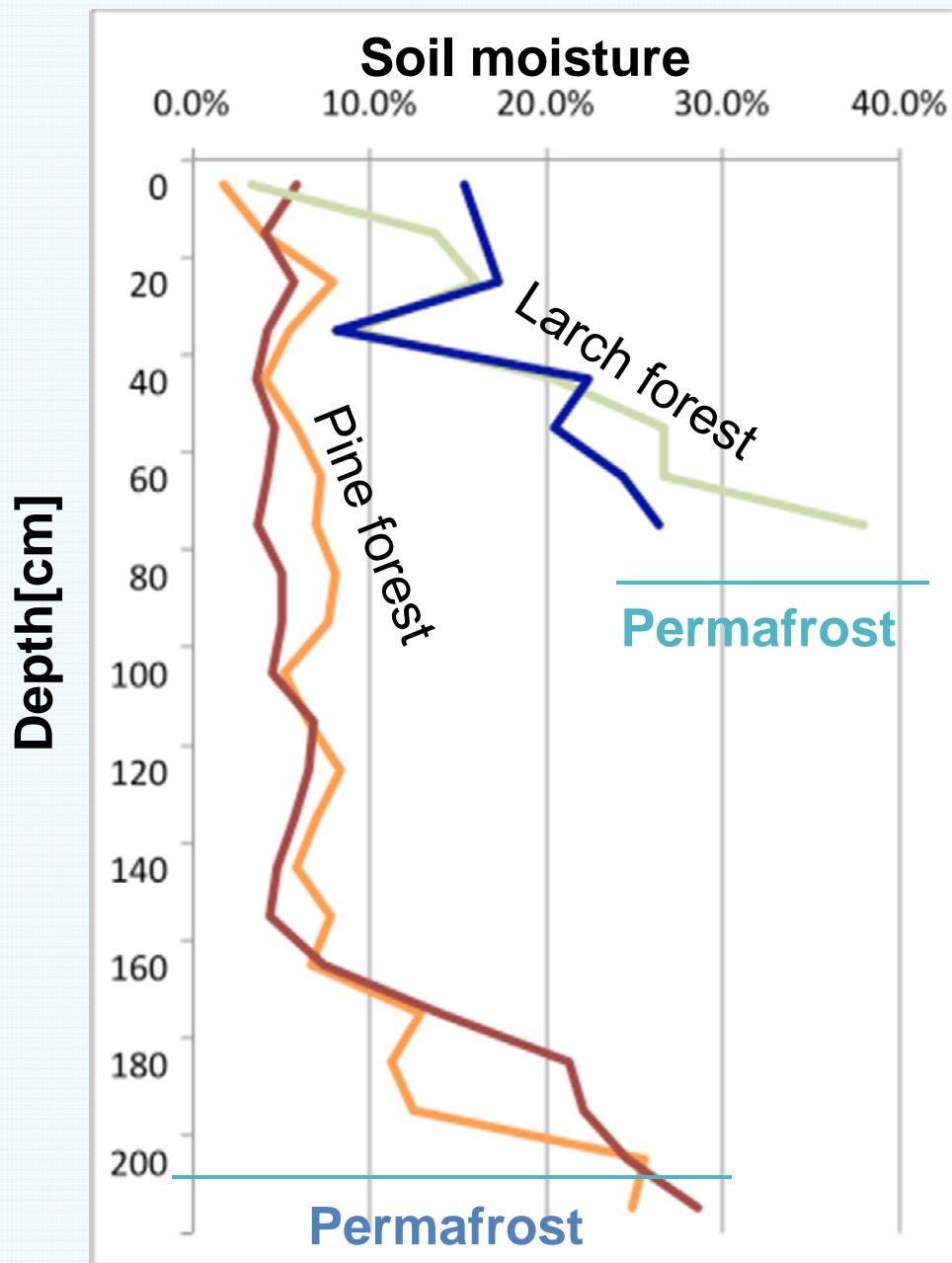


deciduous herbs and shrubs

evergreen shrubs

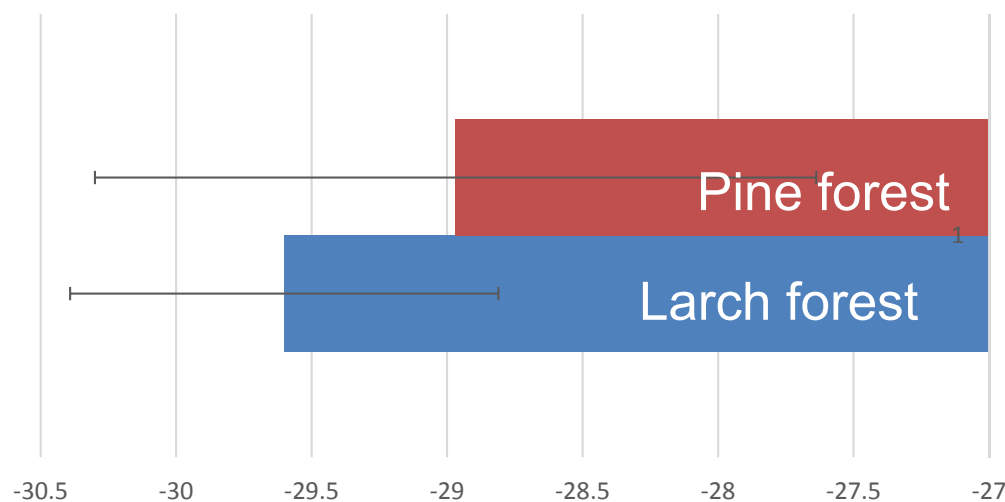
◆ Larch C% ■ Pine C%

Soil moisture calculated by Time Domain Reflectance & Volumetric Water Content



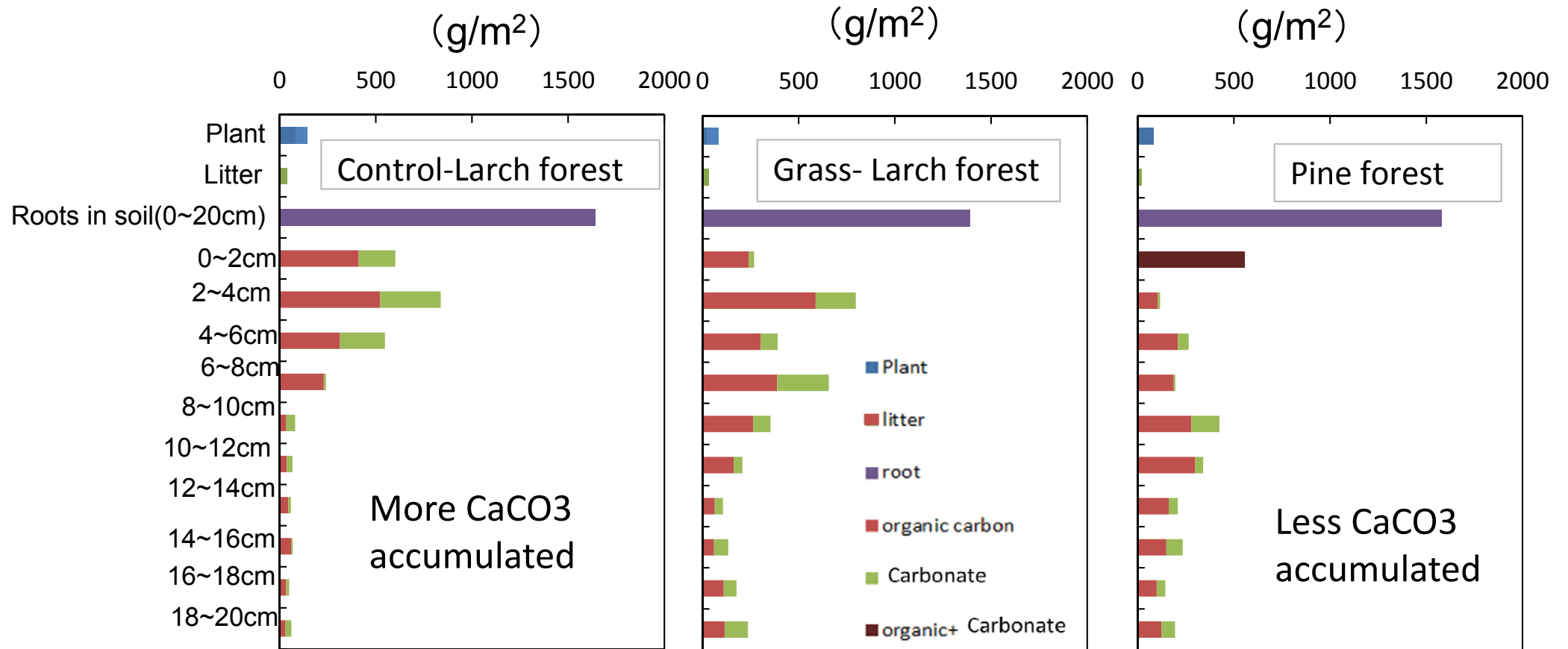
Only deciduous species

average $\delta^{13}C$



Pine forest - dry soil \rightarrow Higher $\delta^{13}C$
Larch forest - wet soil \rightarrow Lower $\delta^{13}C$

C stock and the amount of Carbonate in the soil



Amount of carbonate

| | Control 2 (g/m ²) | Grass3 (g/m ²) | Pine1 (g/m ²) |
|---------|-------------------------------|----------------------------|---------------------------|
| 0~10cm | 1592.0 | 1364.1 | 222.3 |
| 10~20cm | 195.8 | 697.1 | 185.1 |

Conclusion of mini research

- Carbon isotope ratios of plants are indicators of the environmental condition:
 - Larch forest low $\delta^{13}\text{C}$ – wet soil condition
 - Pine forest high $\delta^{13}\text{C}$ – dry soil and open surface

- CaCO_3 accumulate more in Larch forest, because in Larch forest, the diversity of vegetation is greater than in Pine forest → more Leaf area index → more transpiration

Siberian larch forests and the ion content of thaw lakes form a geochemically functional entity

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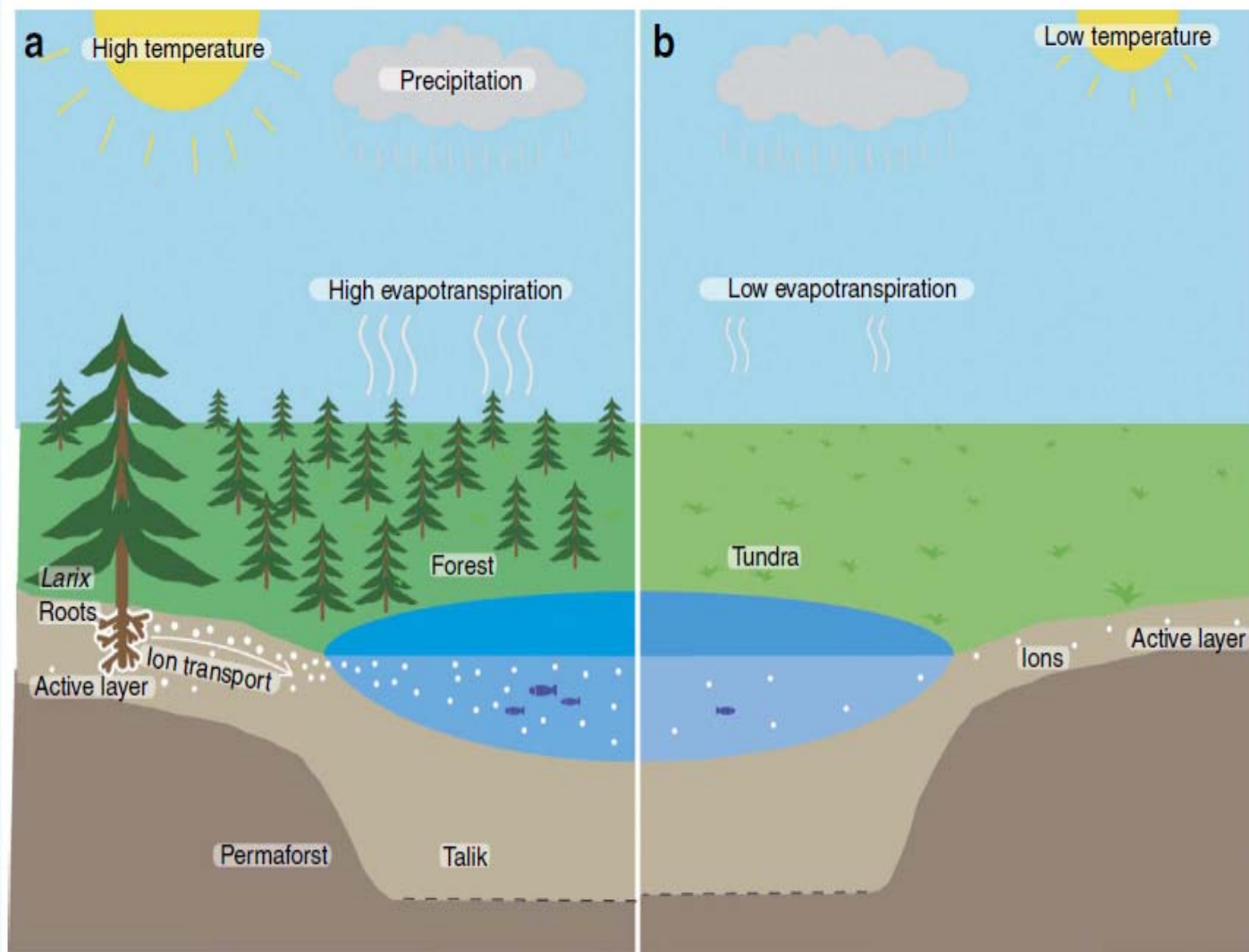
Introduction: Conceptual model visualization

Forest:

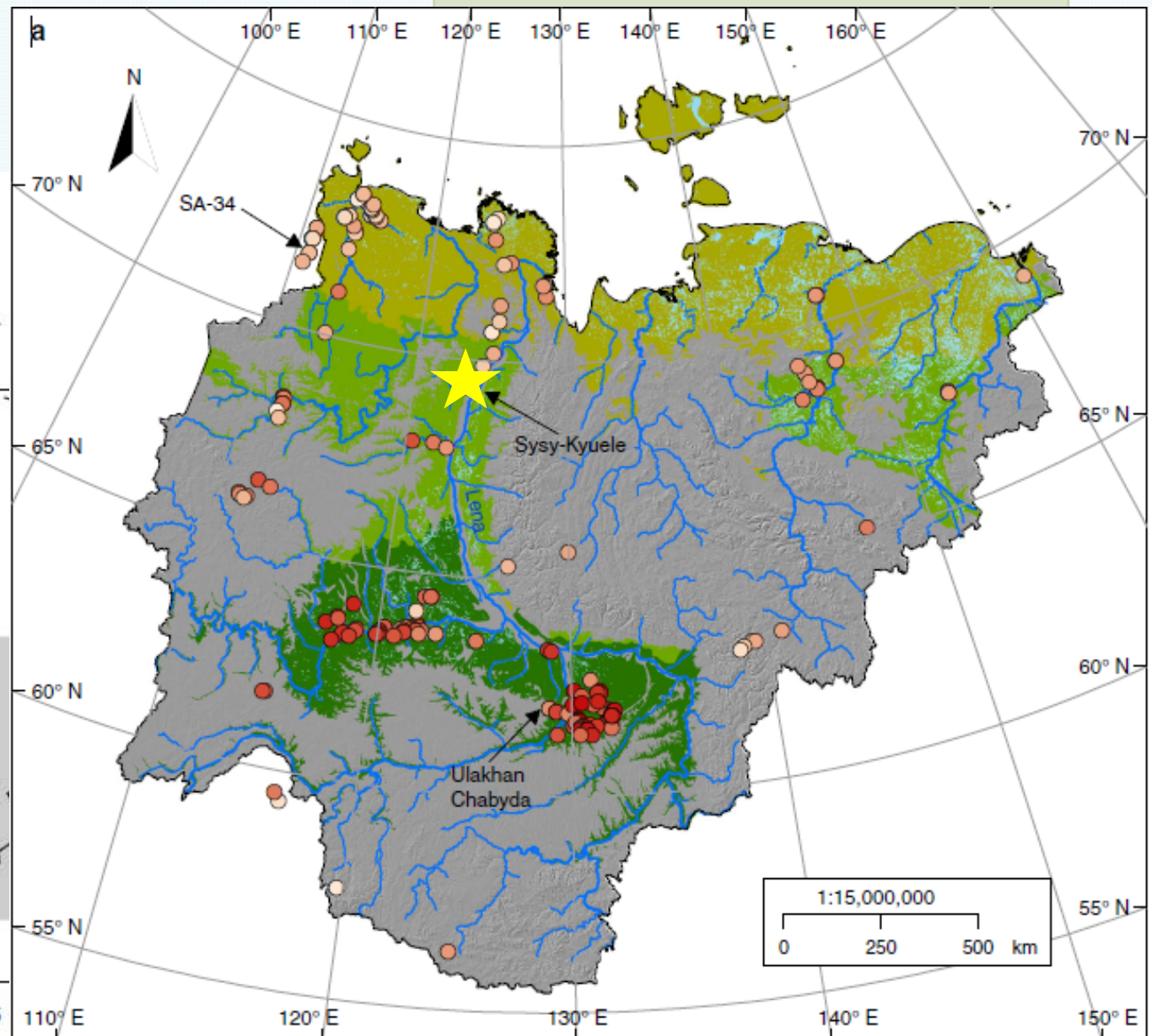
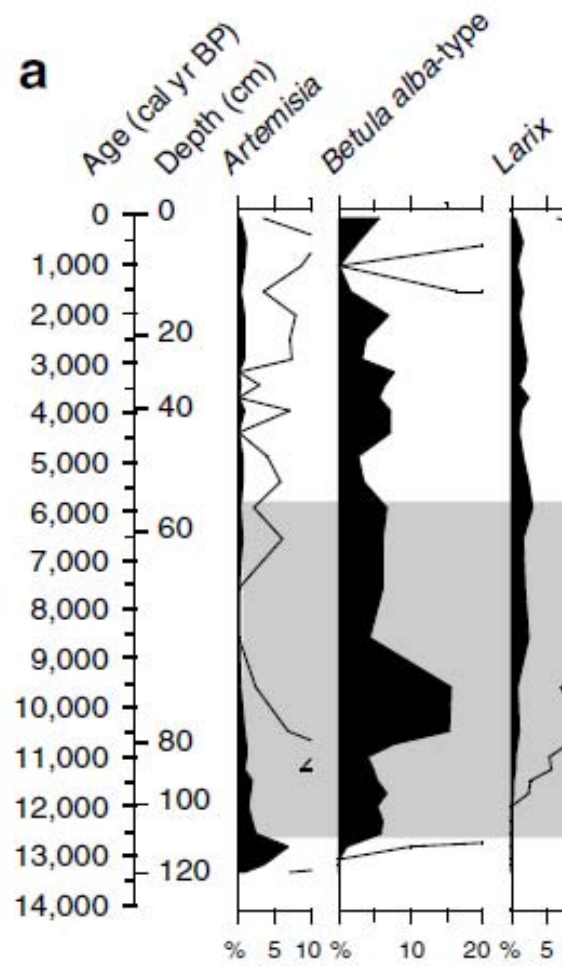
- More vegetation
- More Leaf Area Index
- High evapotranspiration → Salt accumulation

Tundra:

- Little vegetation
- Low Leaf Area Index
- Low evapotranspiration → Not salt accumulation



Results: Lake Sysy Kyuele sediment core and Holocene forest-tundra transition



Summary:

1. Interactions between permafrost, larch forest and thaw lakes represent a missing link in understanding the mineral and inorganic carbon cycling in the lowlands of Siberian taiga forests
2. Thaw lakes represent a major and, on millennial to decadal scales, highly variable carbon reservoir

CONCLUSION

- Conducted mini research and reading scientific articles helped to better understand the Arctic ecosystems, specific processes that occur in them, allowed me to expand the field of knowledge on the issue of accumulation of ions, salts, carbon in areas with permafrost.
- In the future, these studies allow us to compare the mechanisms of accumulation of soluble salts in the Eastern and Middle Siberia. Where permafrost plays an important role in these processes.
- These data will help me to broaden my scientific research in the future.

Thank you for your attention!