UiO : Department of Geosciences
UiO : Kulturhistorisk museum
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Climate variability controlled the development of the pre-Viking society during the Late Antiquity in Southeastern Norway

Manon Bajard

Ballo E., Høeg H., Støren E., Bakke J., Hagopian W., Jahren A., Loftsgarden K., Iversen F., Svensen H., Krüger K.

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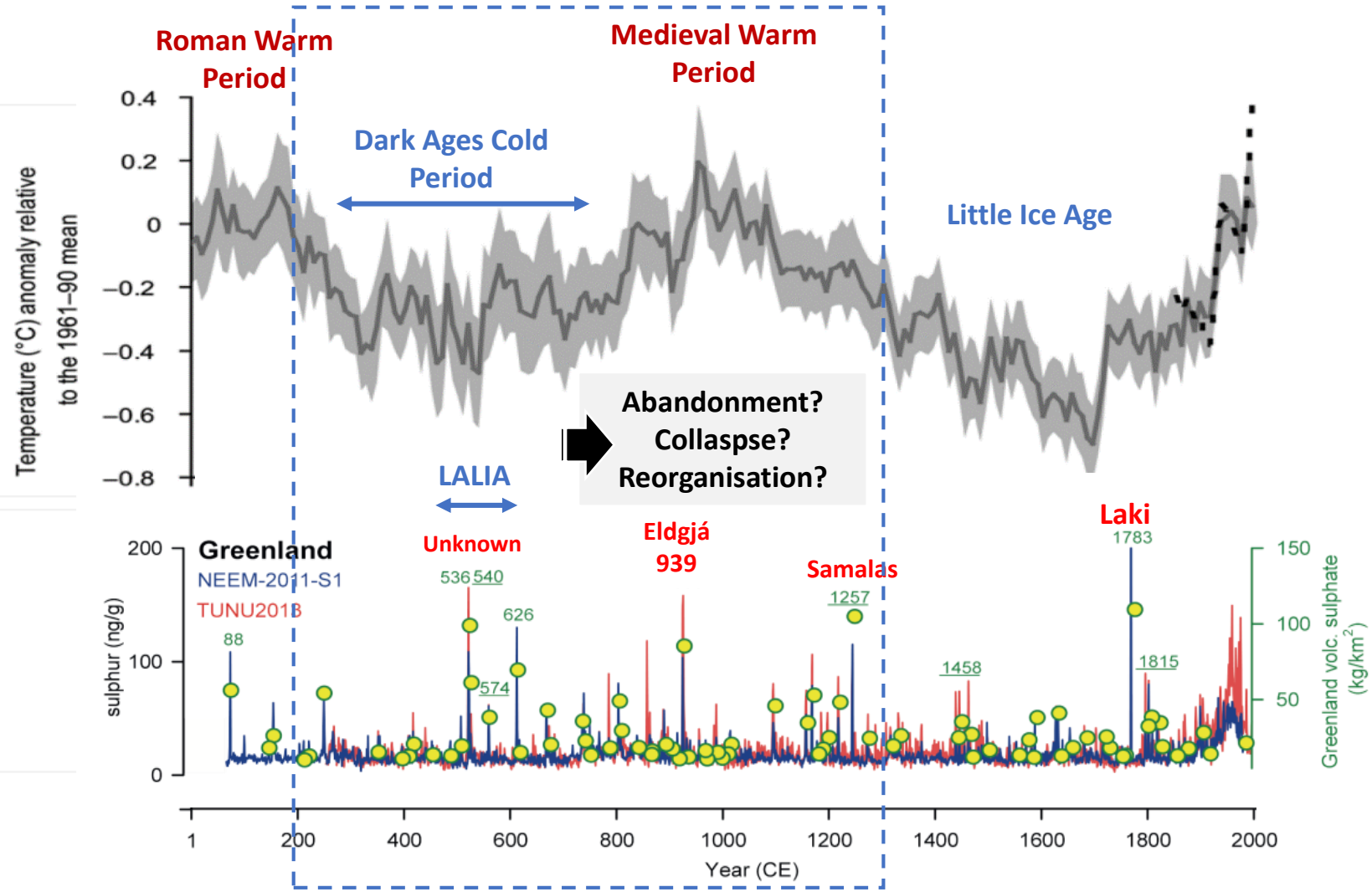
Introduction

Socio-environmental interactions in the **period 200-1300 in Scandinavia**: **How past societies adapted to climate changes?**

→ new records of climate and societal changes from lake sediments

Temperature in the Northern Hemisphere

Volcanic forcings



Ljungqvist 2010

Extratropical NH Temperature Records of proxys

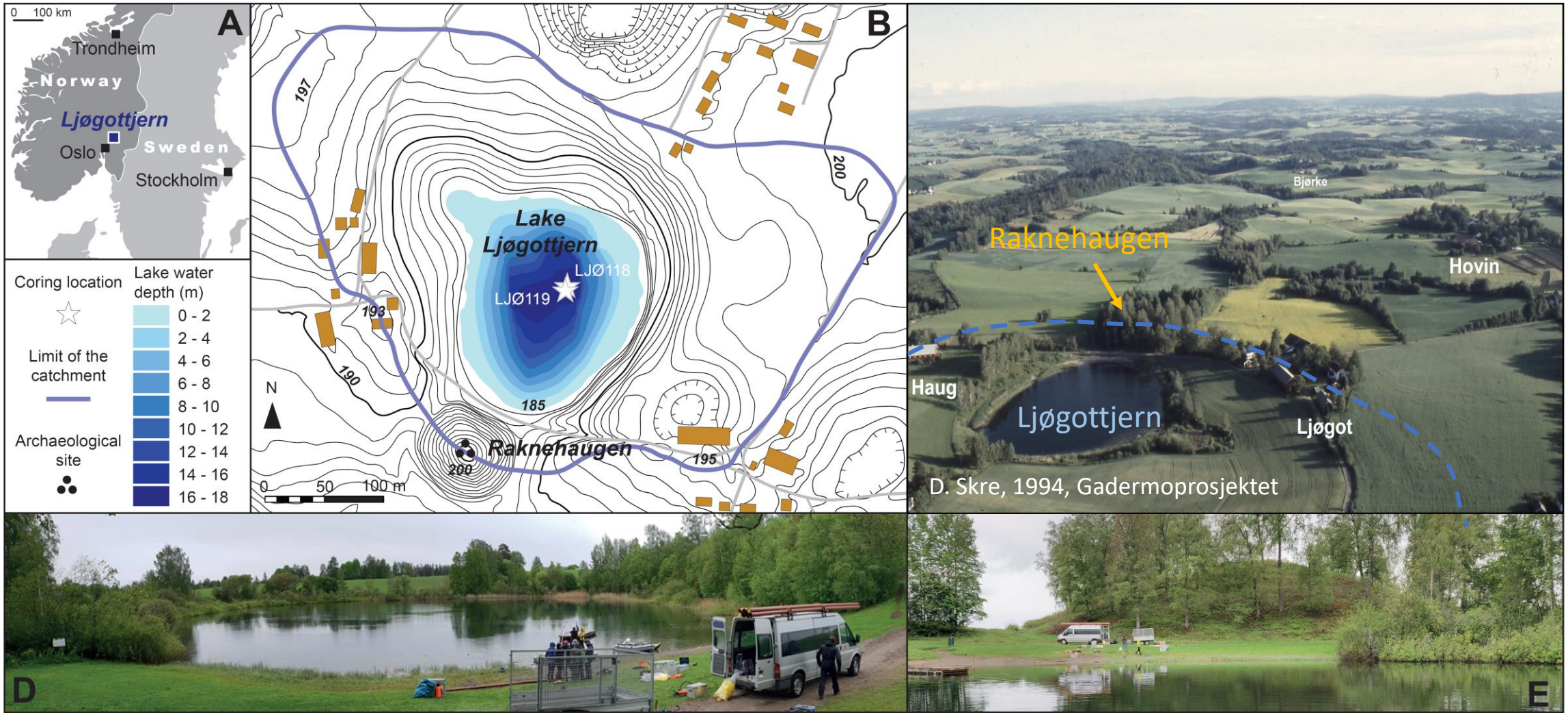
Büntgen et al., 2016
Helama et al., 2017

after Sigl et al., 2015

Location of the study site

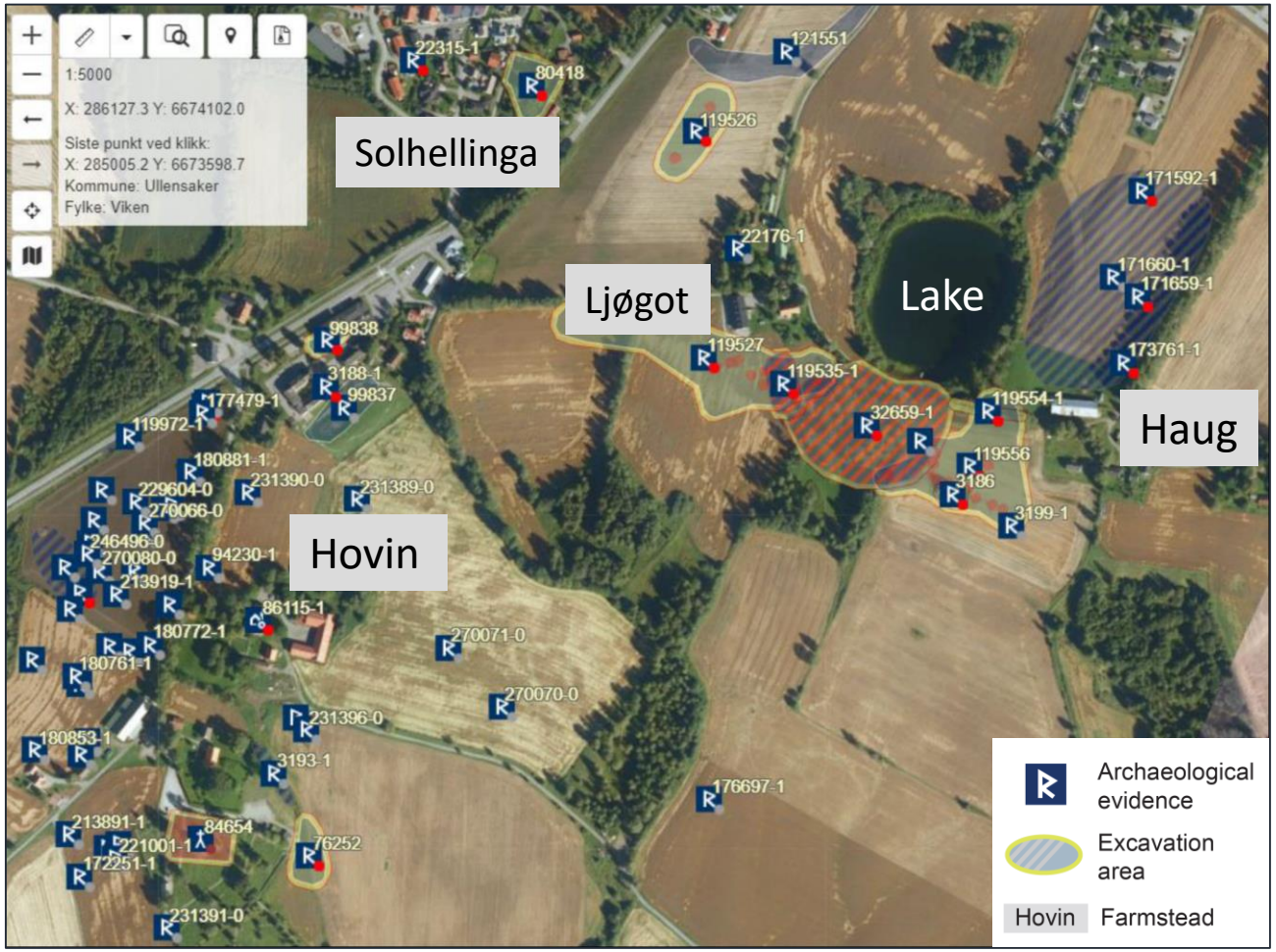
Kettle lake
185 m asl.
No inlet or outlet
18 m of water

Lake Ljøgottjern, Norway (close to Oslo airport)

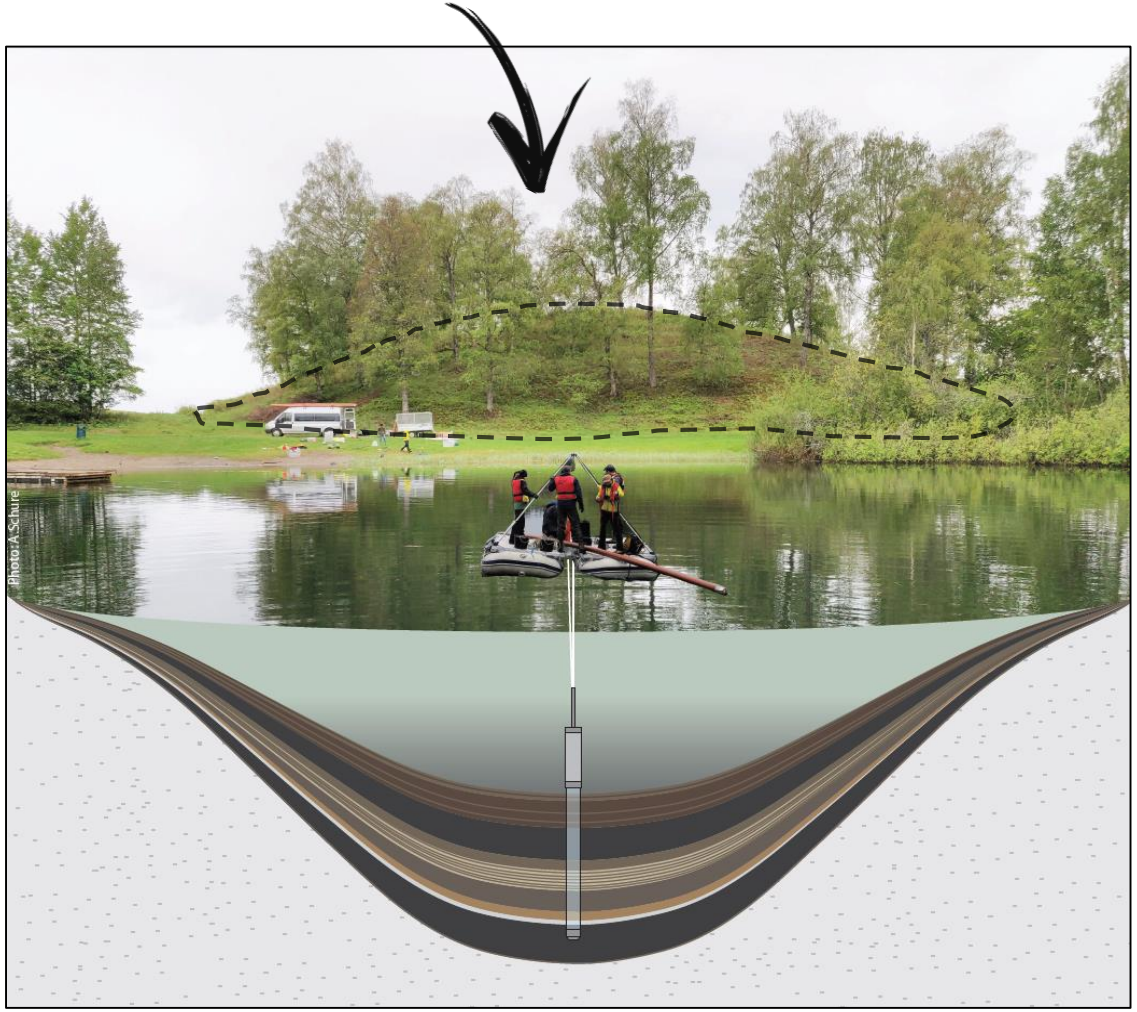


Large archaeological context

Raknehaugen: largest burial mound in Northern Europe
Several local farmstead from the Bronze Age and Iron Age



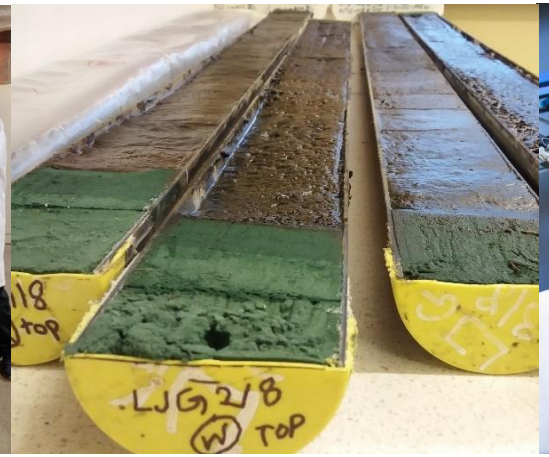
Raknehaugen build in the mid-6th century



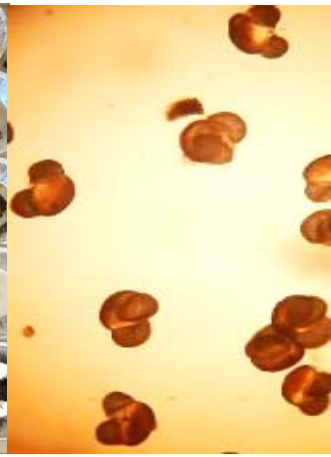
Materials and methods

→ 2 cores from the same lake

cut | split | log/describe | XRF core scanner | sampling

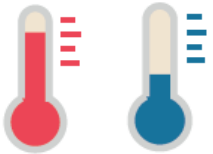





1 **XRF core scanner**
→ Geochemical composition

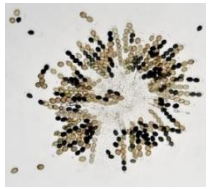
Ca/Ti →

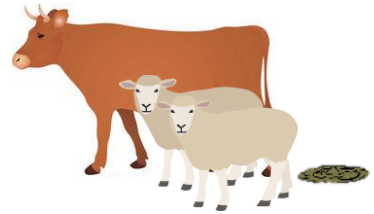


2 **Palynology: pollen analysis**
→ Plants



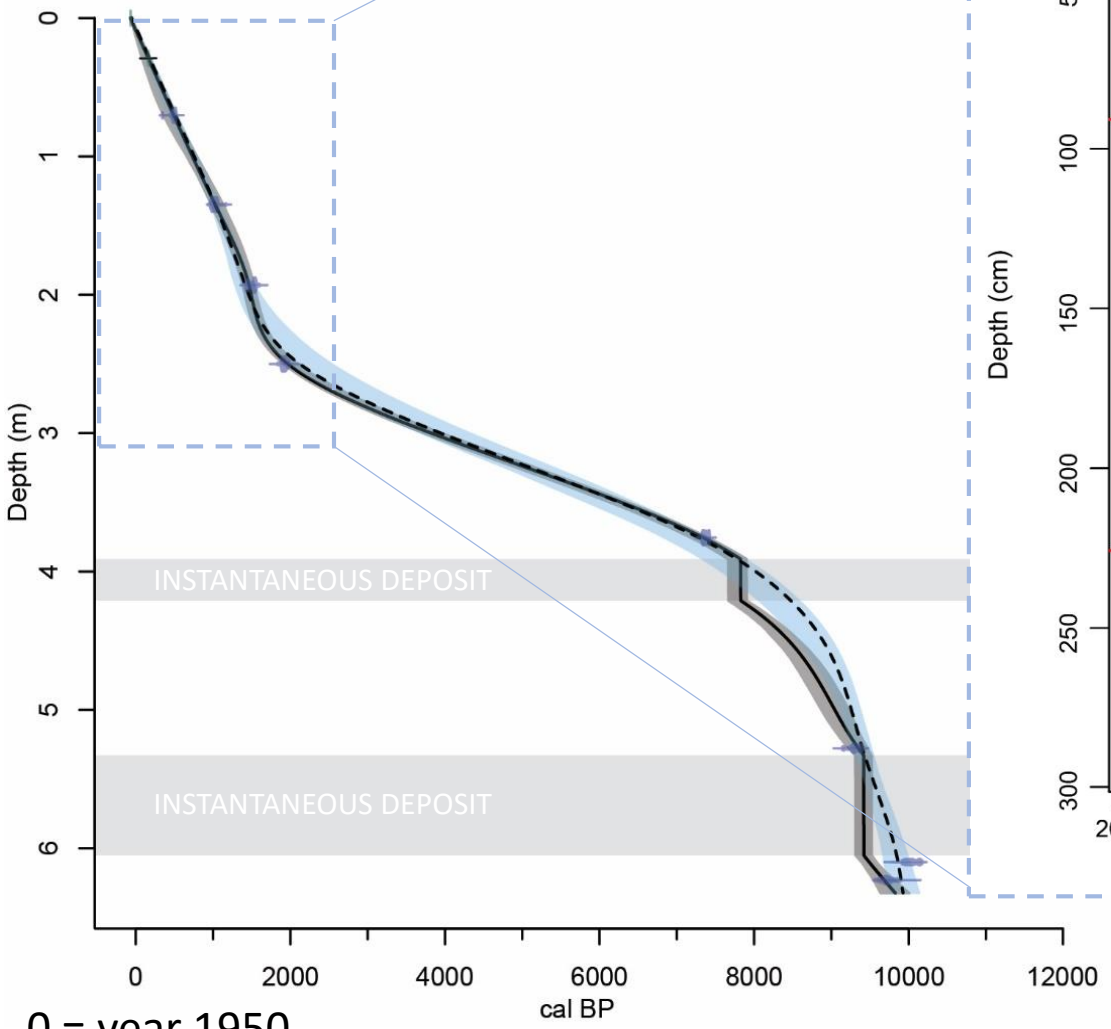
Coprophilus fungi *Sordaria*
→ Animals

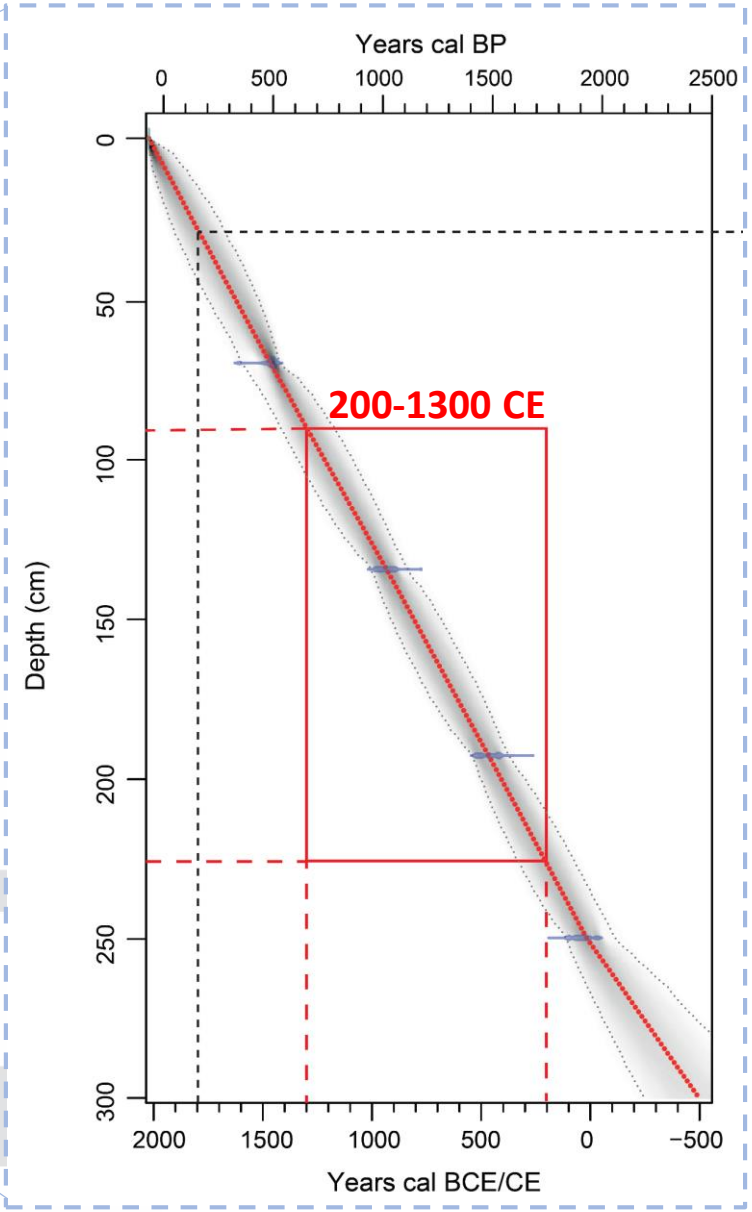




Chronology

Dating: carbon 14 on plant macro remain





0 = year 1950

Bajard et al., 2021, submitted.

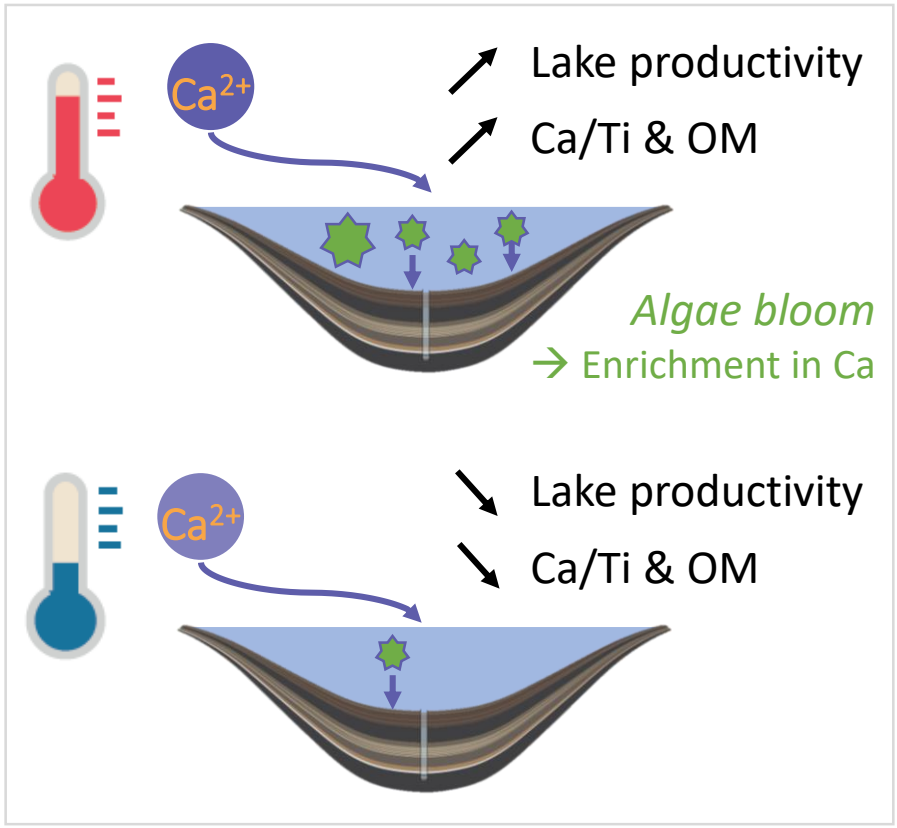
1

Temperature

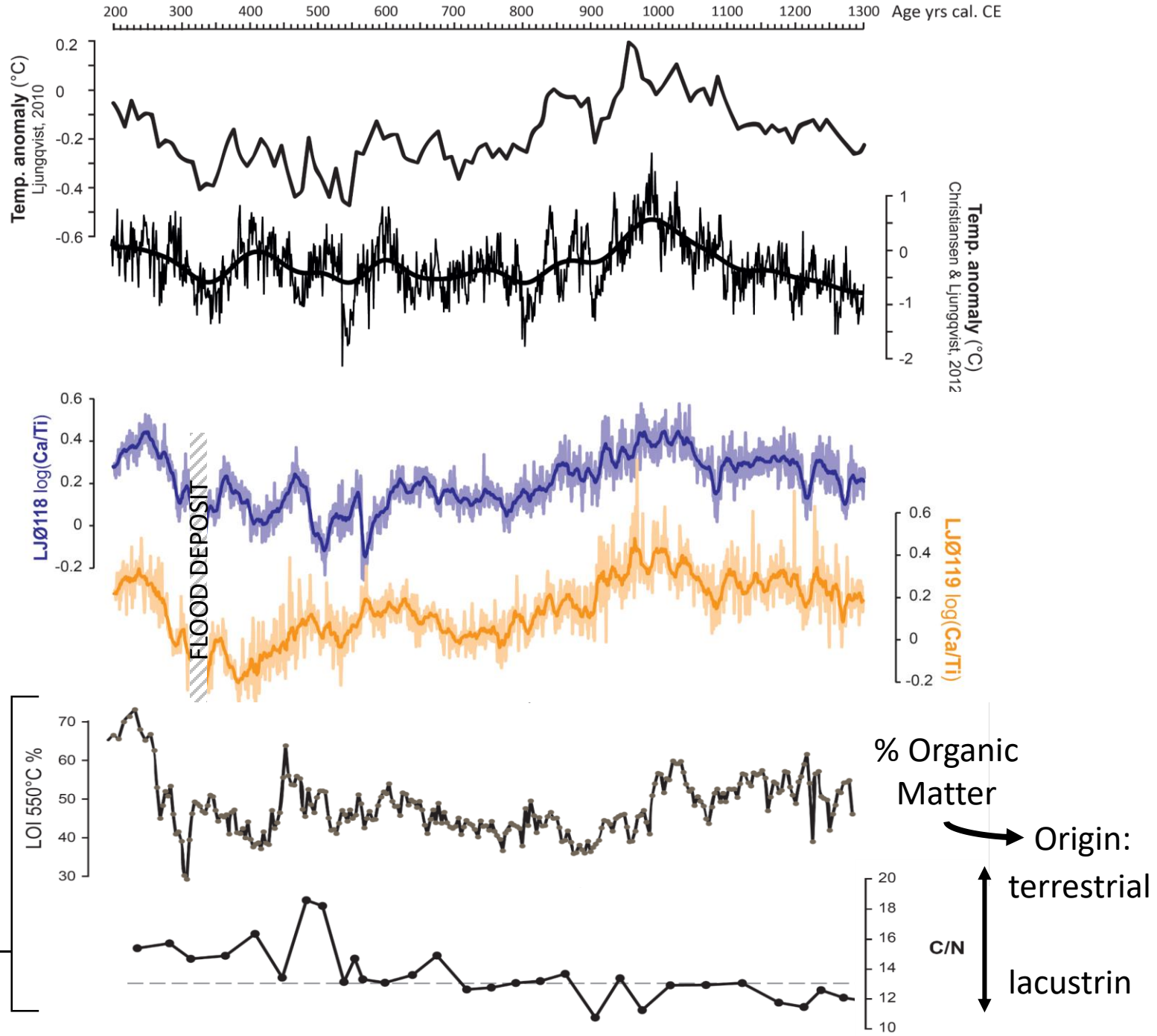
Proxy: Ca/Ti

Measured on the 2 cores **LJØ118** and **LJØ119**

Hypothesis:



Verification of the Organic Matter (OM) content and origin:
→ Similar trend as Ca/Ti

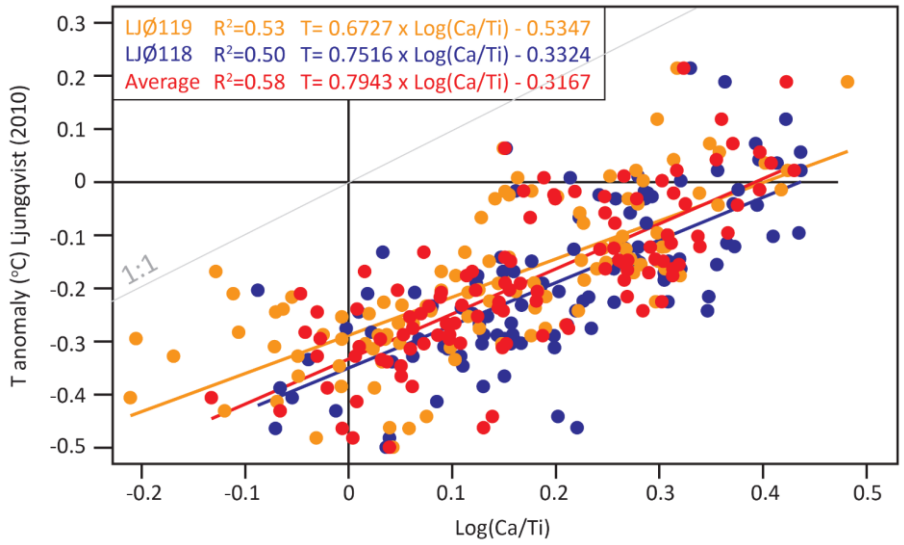


Bajard et al., 2021, submitted.

Temperature

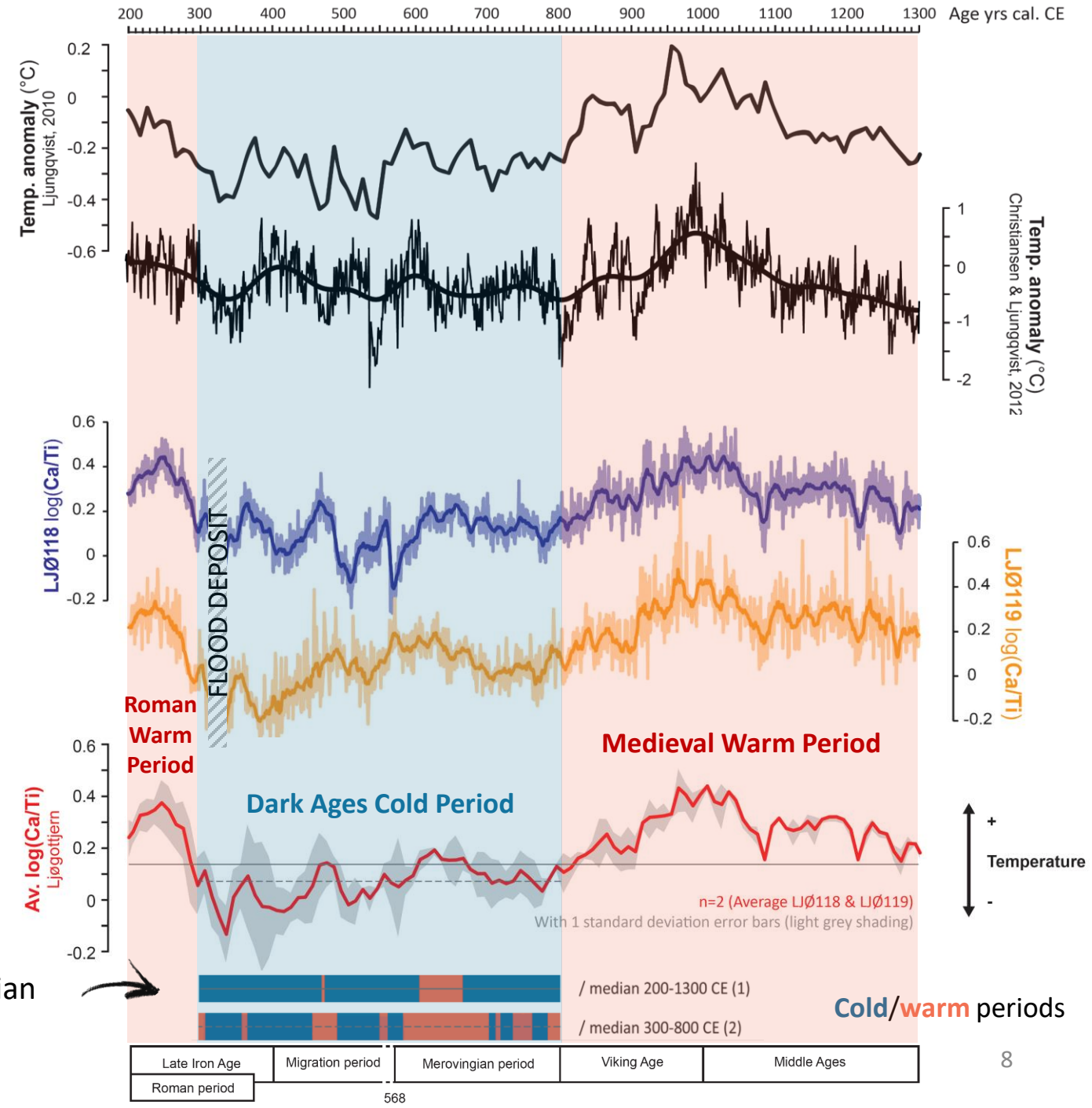
Proxy: Ca/Ti
Measured on the 2 cores **LJØ118** and **LJØ119**

Linear relation between **Ca/Ti and temperature** recorded in the Northern Hemisphere



We defined **cold** and **warm** periods according to the median
/ period 200-1300 CE (1)
/ period 300-800 CE (2)

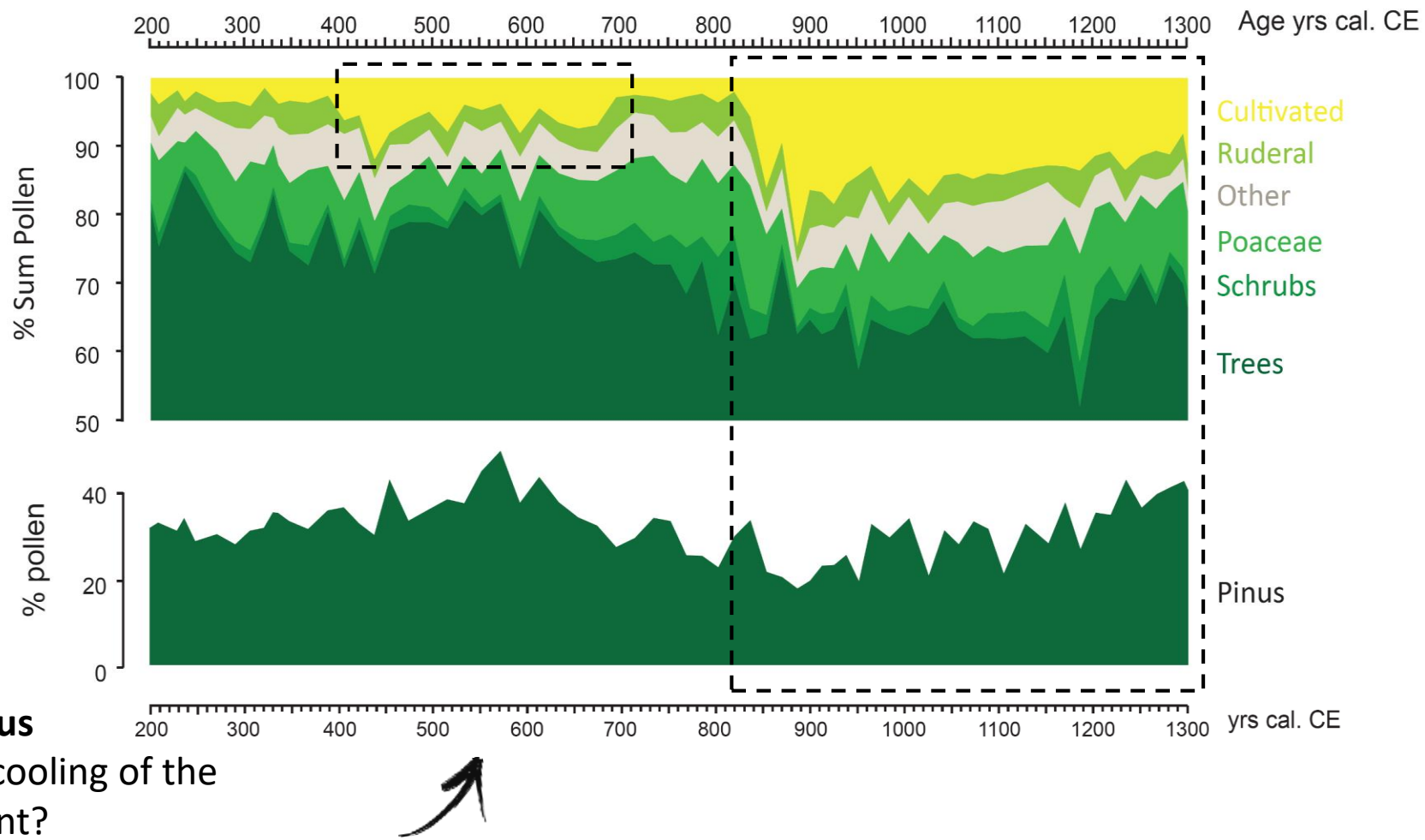
Bajard et al., 2021, submitted.



Pollen and coprophilus fungi

400-700 CE:
Period with higher percentages of pollen of cultivated species

After 800 CE:
Transition toward a much more open agricultural landscape
Larger deforestation and cultivation of cereals and hemp

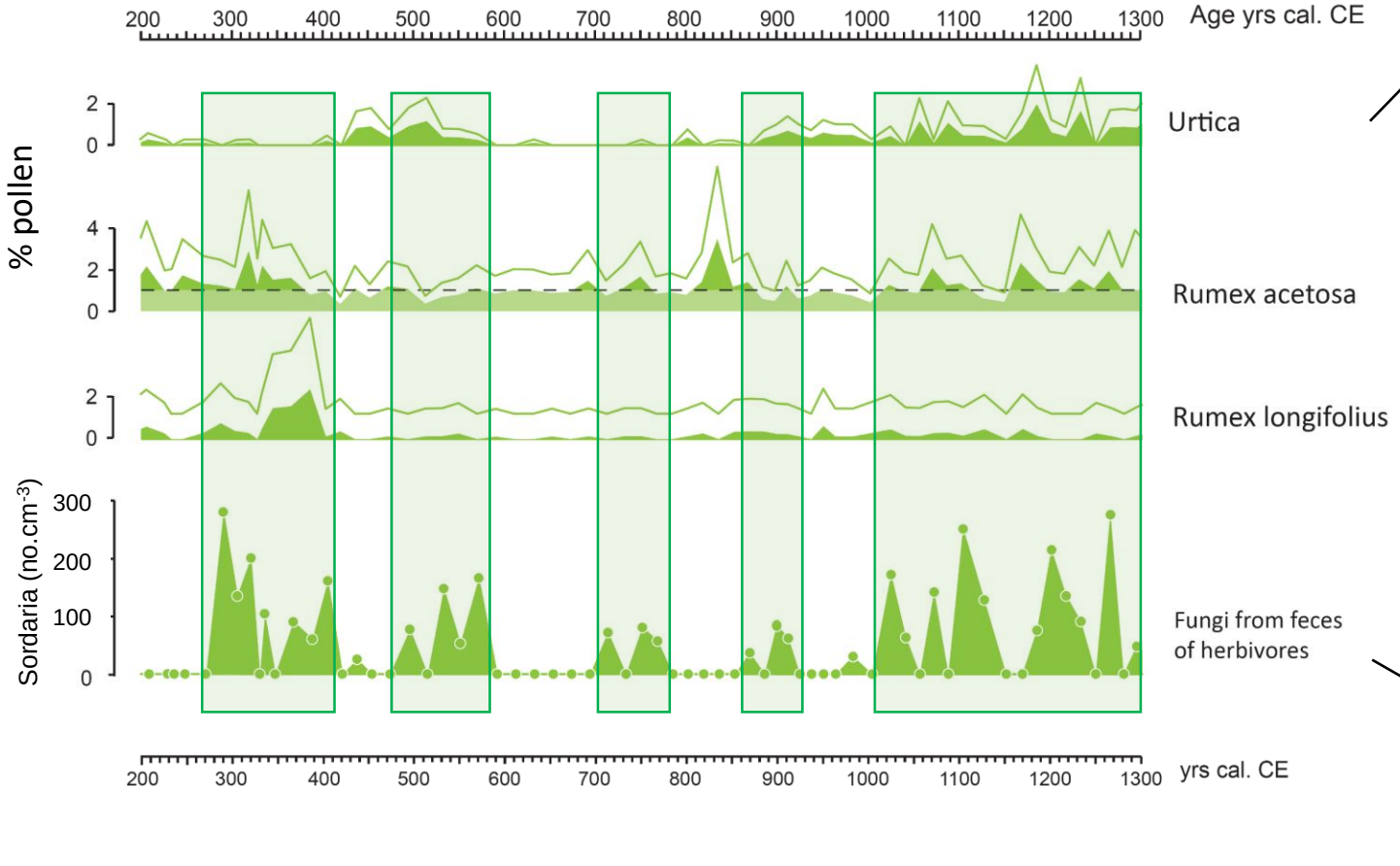


Mid 6th century:
Peak of pollen of Pinus
Consequence of the cooling of the 536-540 volcanic event?

Bajard et al., 2021, submitted.

Pollen and coprophilus fungi

→ **Livestock farming**



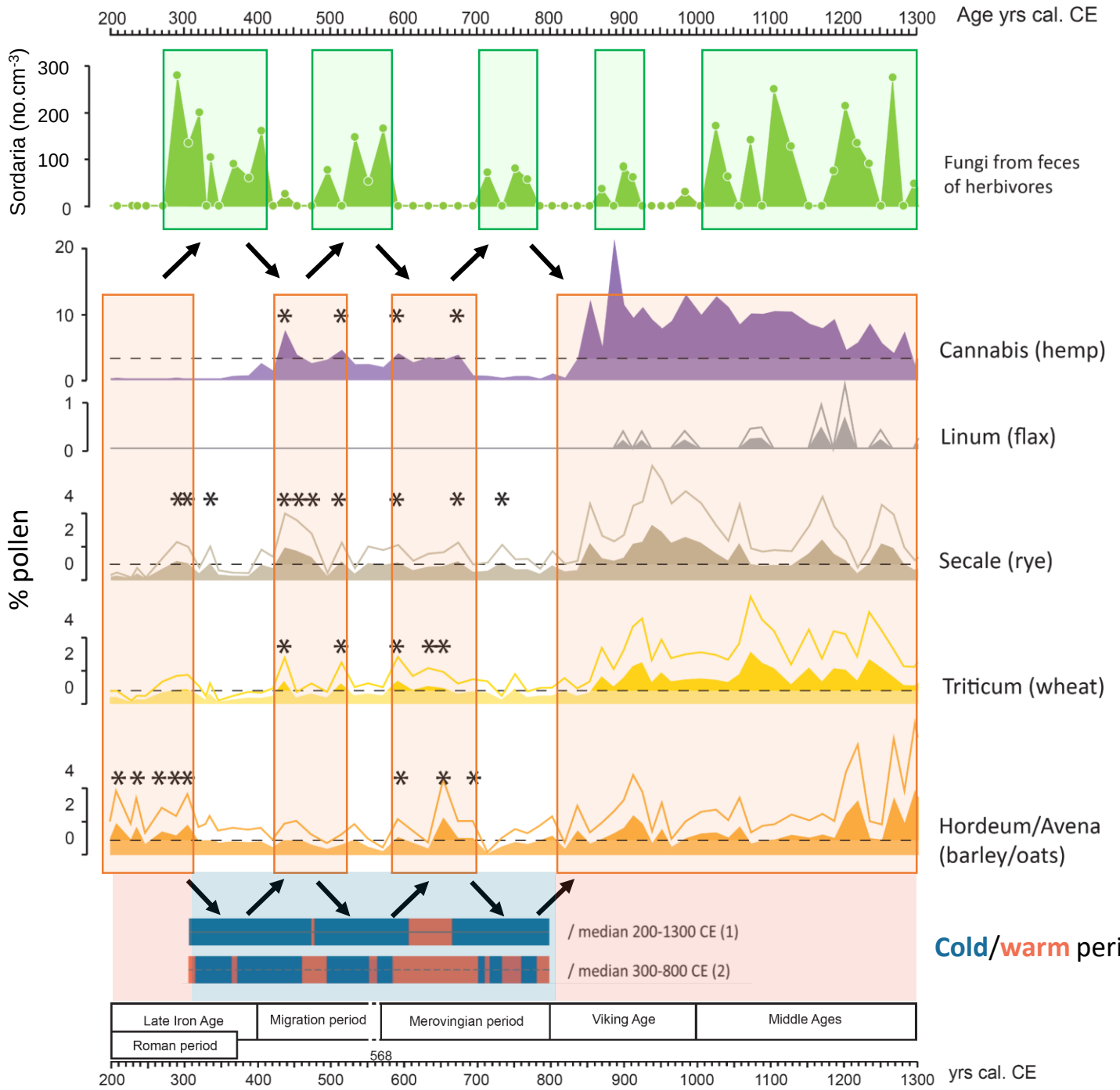
→ *Urtica* (needles) and *rumex*: indicators of nitrogen enrichment in soils, associated to animal husbandry

→ *Sordaria* is a fungi commonly found in the feces of herbivores

Bajard et al., 2021, submitted.

→ Livestock farming

→ Cultivation of cereals and hemp



Fibres for textile, ropes

Cold/warm periods

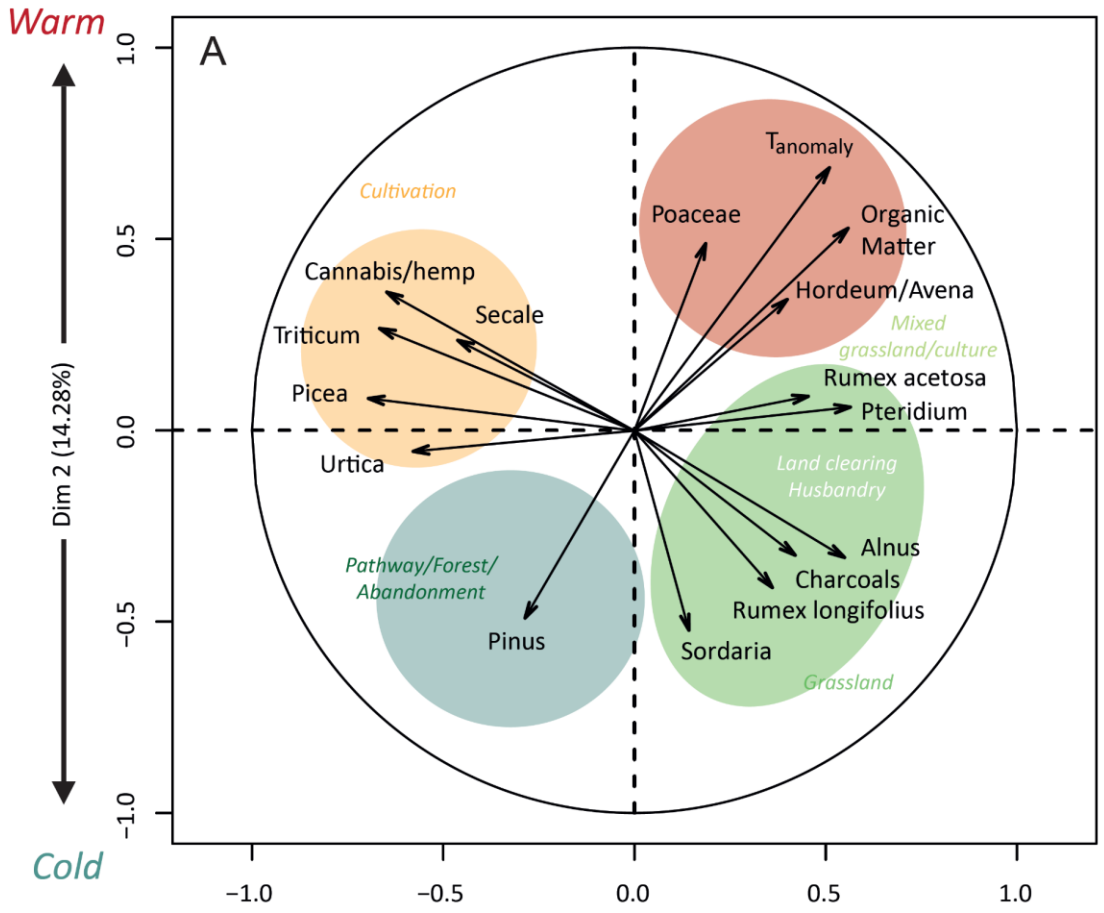
– – – – Median

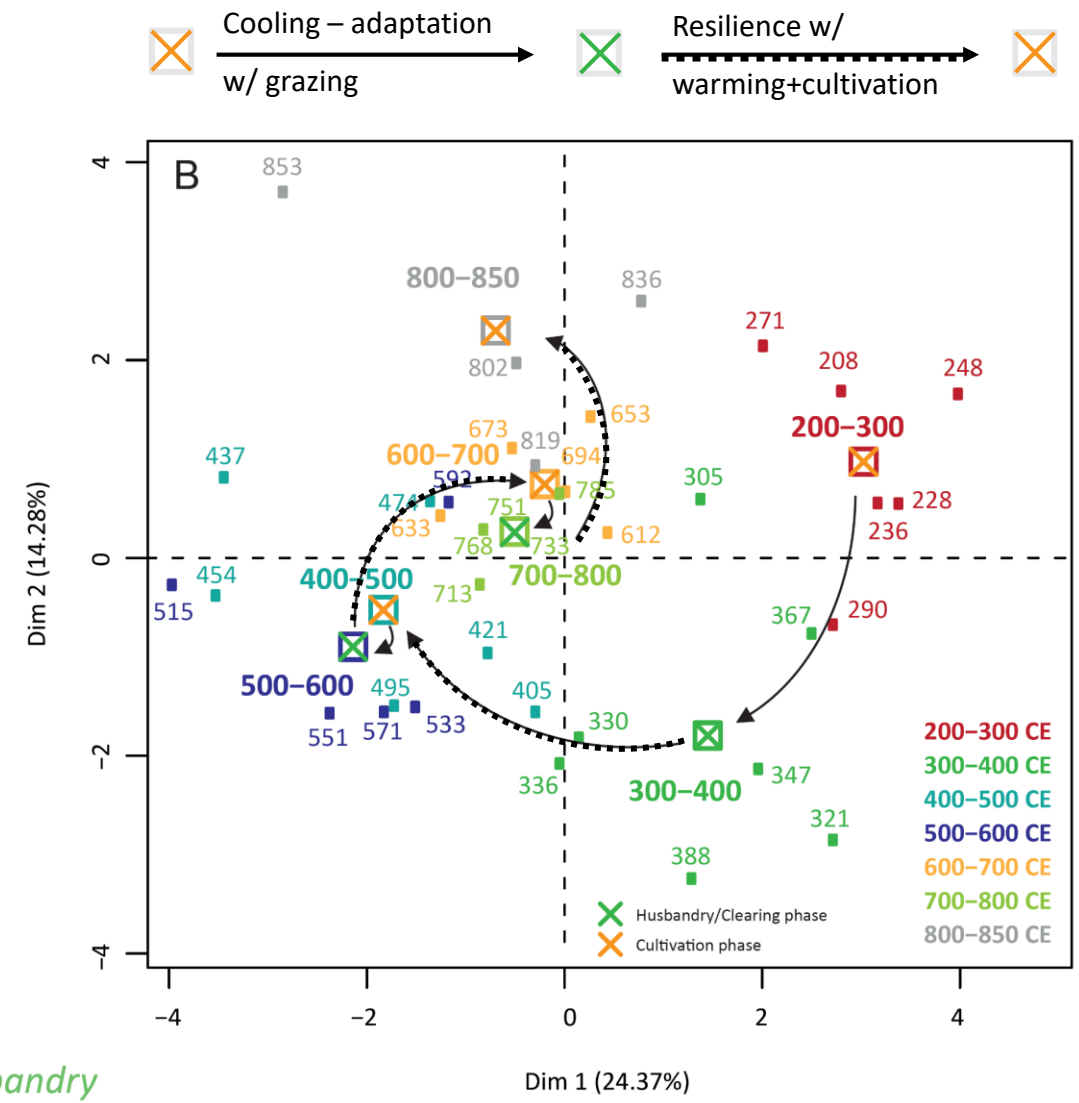
* Above the median before 800 CE

Bajard et al., 2021, submitted.

Trajectories of evolution

PCA Principal Component Analysis





→ Opposition between cultivation practices and husbandry

→ Opposition between warm/cultivation and cold/husbandry

→ Succession of phase of cooling - adaptation w/ grazing, and phase of resilience w/ warming+cultivation

Bajard et al., 2021, submitted.

Take home message

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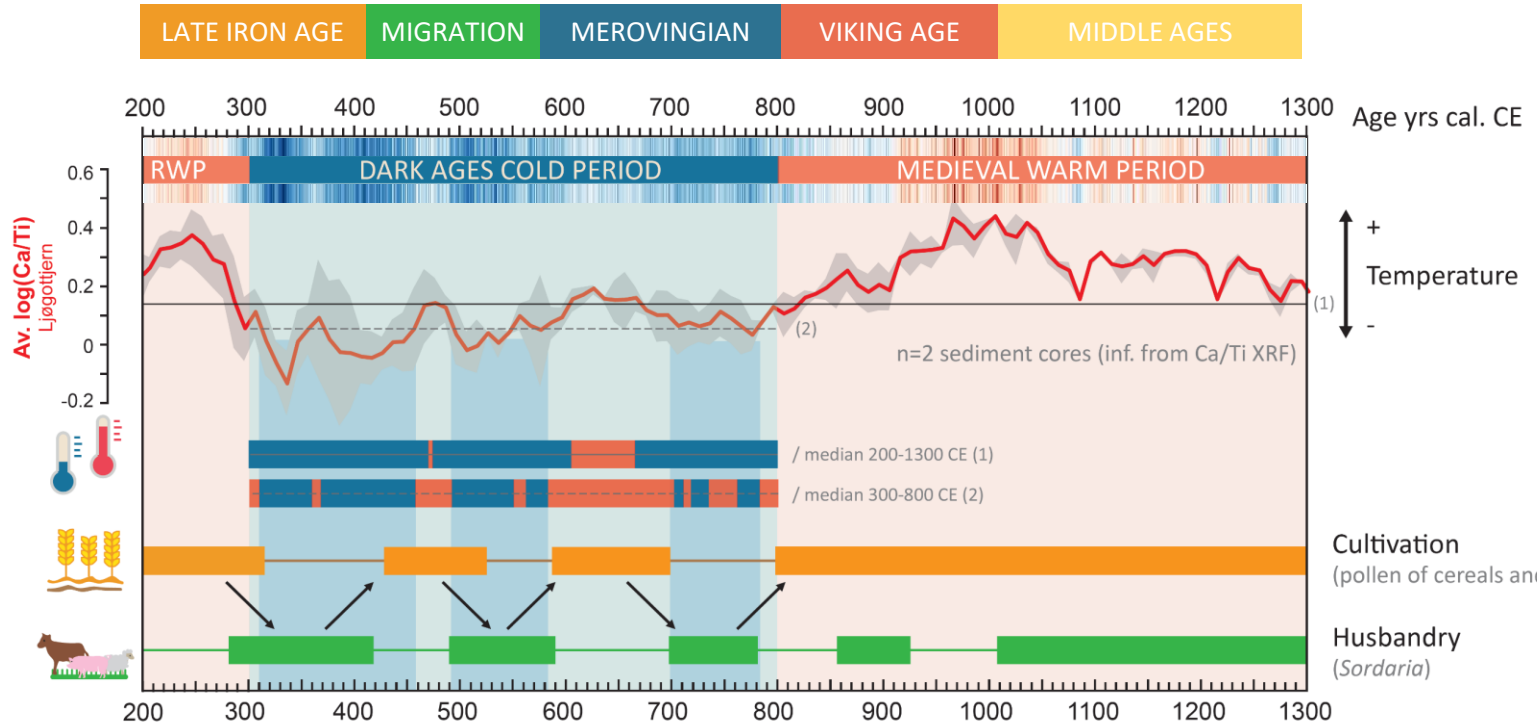

Cultivation	Husbandry
200-280 CE	
	280-420 CE
420-480 CE	
	480-580 CE
580-700 CE	
	700-780 CE
after 800 CE	

- Record of **climate and agricultural** practices on the **same lake sedimentary archive**
- Temperature recorded follows the extra-tropical North Hemisphere trend in the studied period **200-1300 CE**
- Warmer in **[200-300 CE]**, colder in **[300-800 CE]** and warmer in **[800-1300 CE]**
- **Changes in agricultural practices between 200 and 800 CE with climate: the society adapted to climate change**

  → **husbandry when colder vs crop system when warmer**

Bajard et al., 2021, submitted.

Supplement: Geochemistry