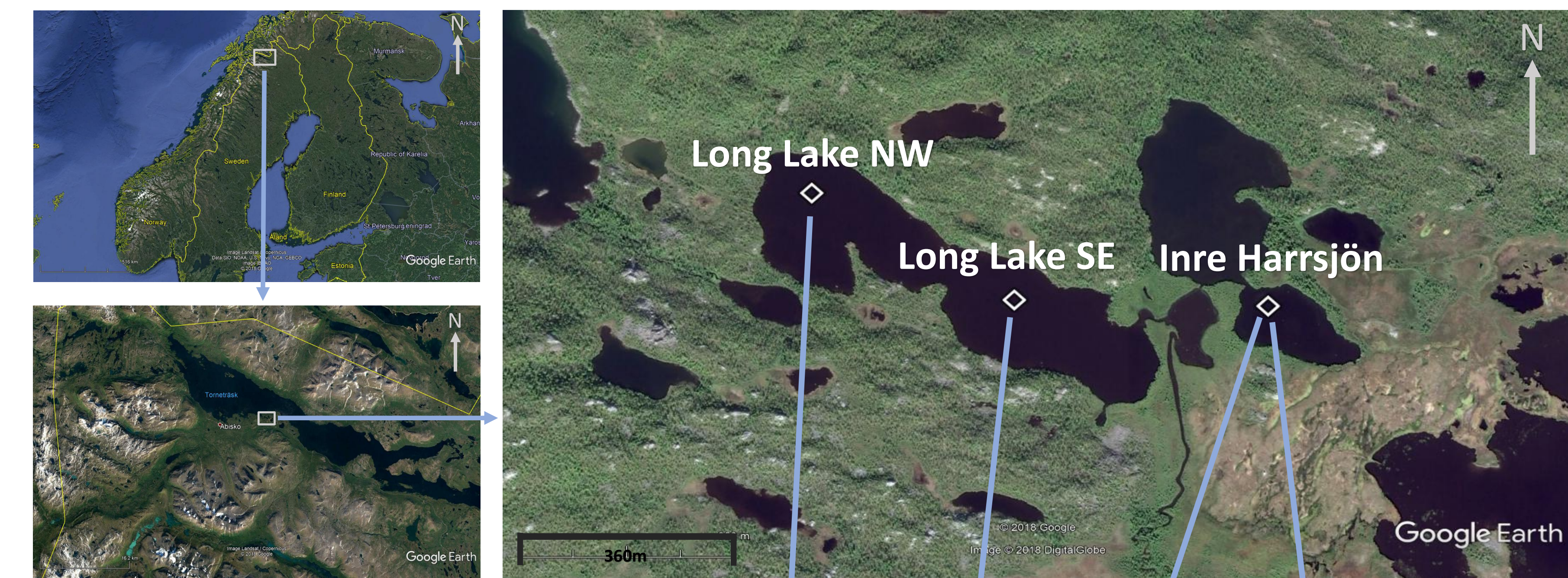


# A Paleolimnological Approach to Climate Change in Subarctic Sweden: Isotopes and Observations of Stordalen Mire Lake Core Records

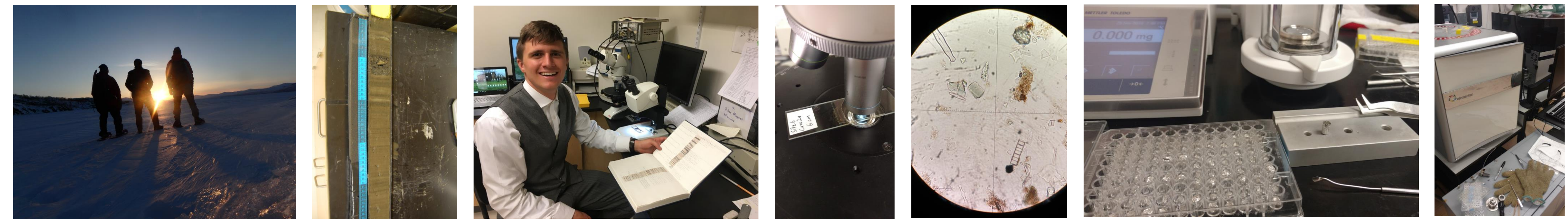
<sup>1</sup>Kellen J. McArthur, Joel E. Johnson, and <sup>1</sup>Ruth K. Varner. Department of Earth Science, University of New Hampshire, Durham. <sup>1</sup>Earth Systems Research Center



Winter lake coring expedition to Stordalen Mire, April 2018. Cores recovered using a Livingstone Piston Corer. Longest record: 9 meters

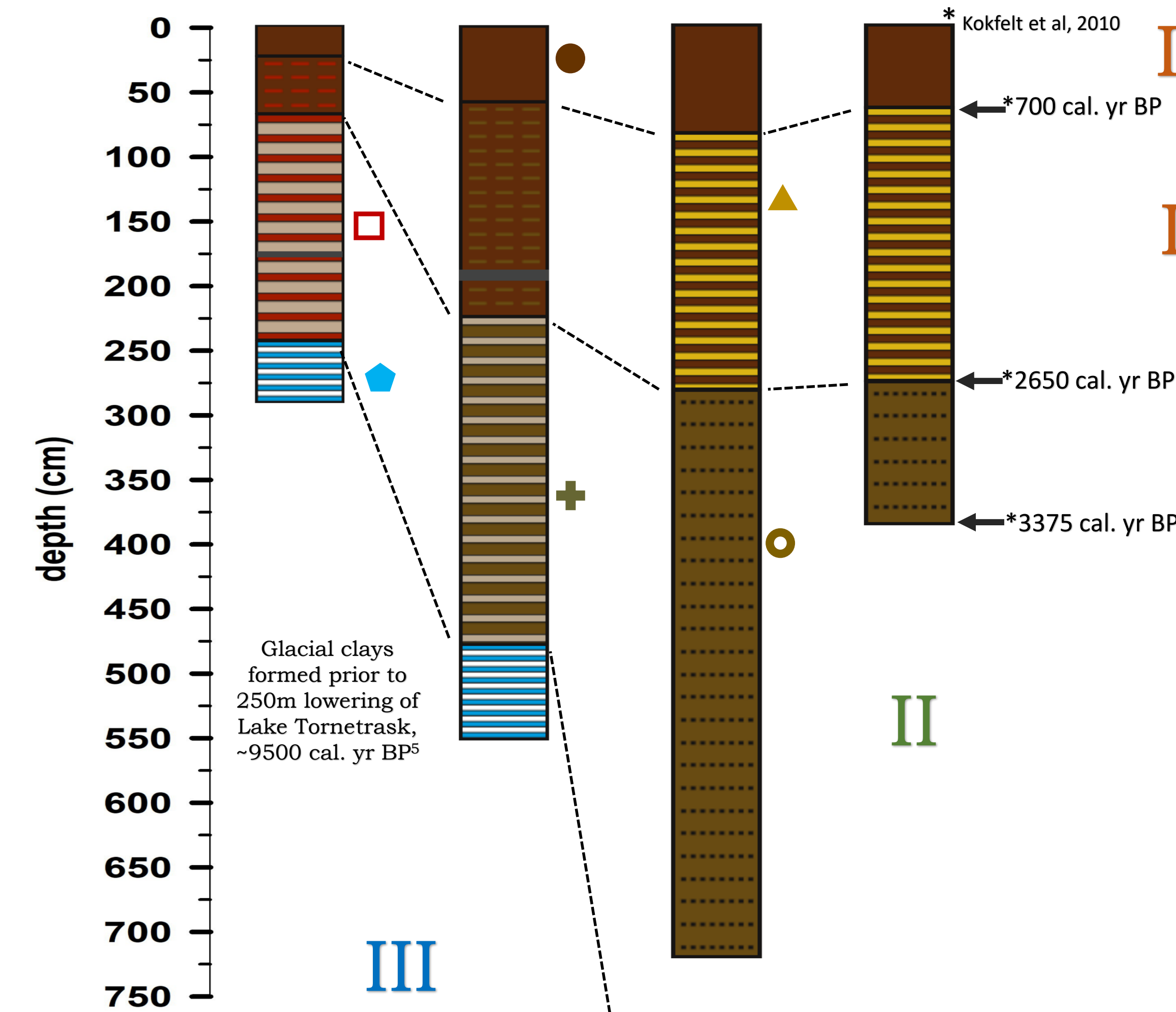
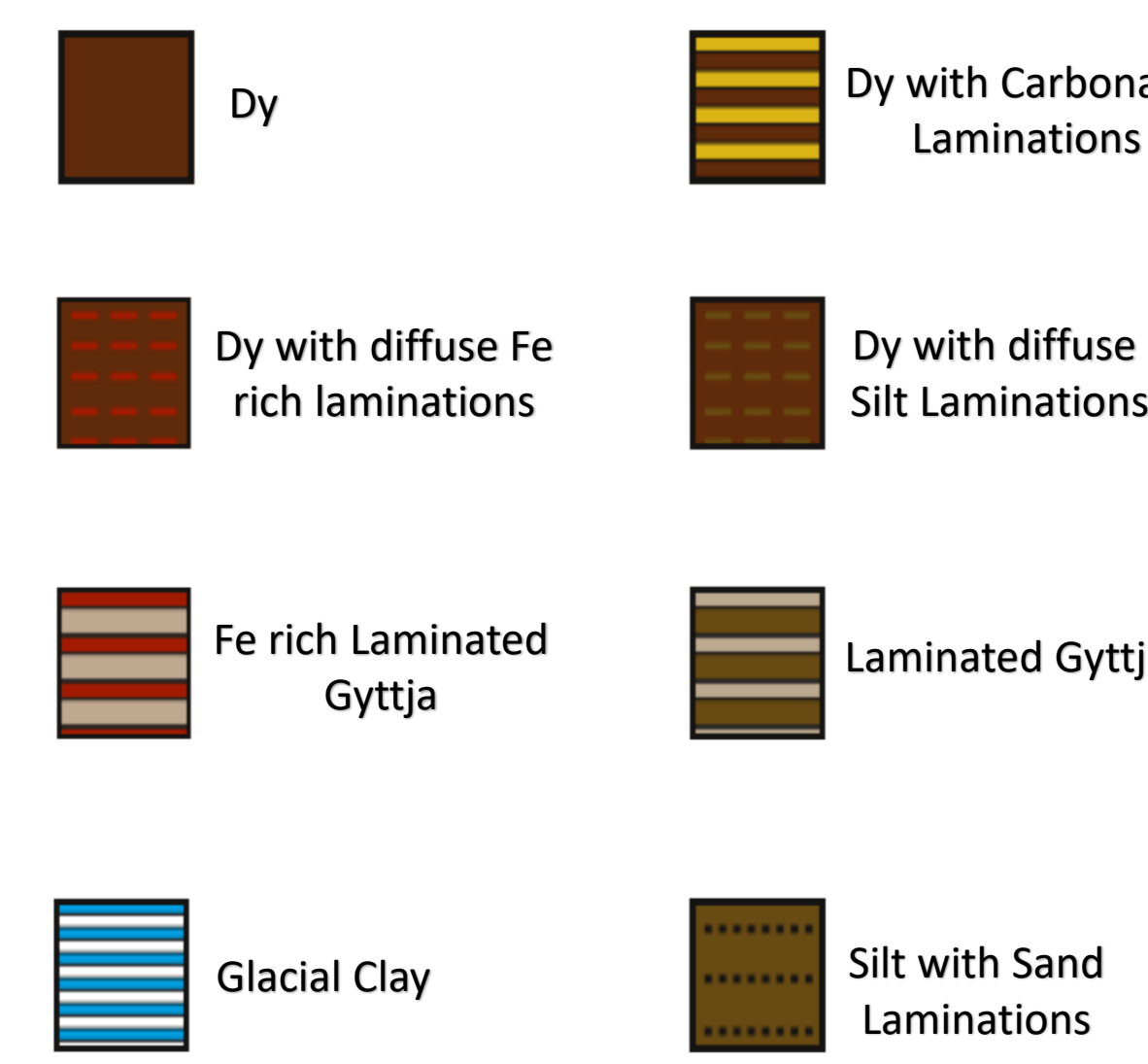


Stratigraphic and lithologic descriptions. Abundance and grain size estimations. Analysis of sediment organic matter: %C, %N,  $\delta^{13}C$ , and  $\delta^{15}N$ .



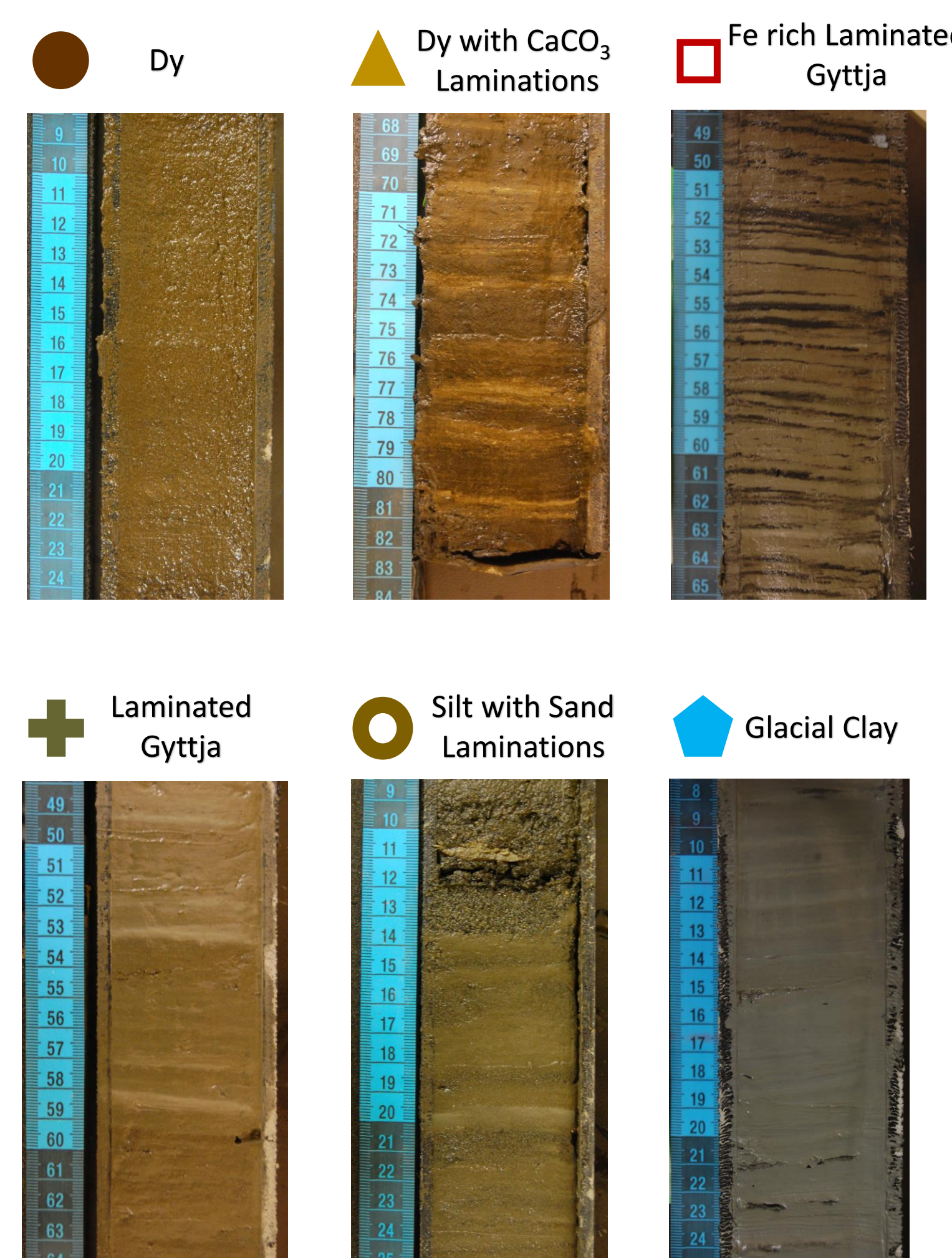
## General Approach

1. Establish and characterize distinct stratigraphic sections
2. Infer the environmental and climatic conditions
3. Determine the age of transitions between sections
4. Compare to existing environmental and climate data
5. Suggest possible scenarios for future change



**Gyttja** ("yit-ja") – Coprogenic, mixed sediment containing plant fragments, diatoms, minerals grains, insect remains. Gray or reddish gray.

**Dy** ("de") – Gytija with brown acid humus colloids added. Brown or blackish-brown



## Holocene Climate Record in Tornetrask Valley:

**late** – Cooling. Forest regression. Permafrost formation

**mid** – Holocene optimum, forest expansion (pine limit 100-150m higher than today)<sup>1</sup>, continental climate.

**early** – Rapid deglaciation, initial terrestrialization and stabilization of soils.

## Initial Observations of our Cores:

**I: late** – No or weak cyclic deposition. Increased carbon deposition. Low minerogenic input

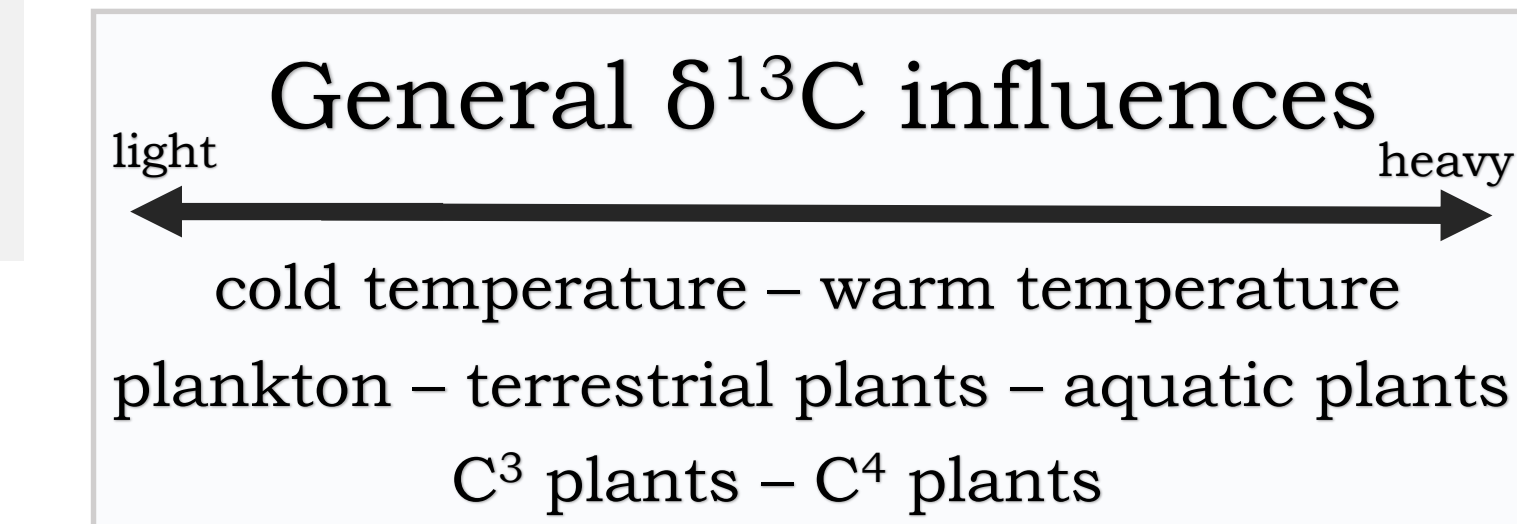
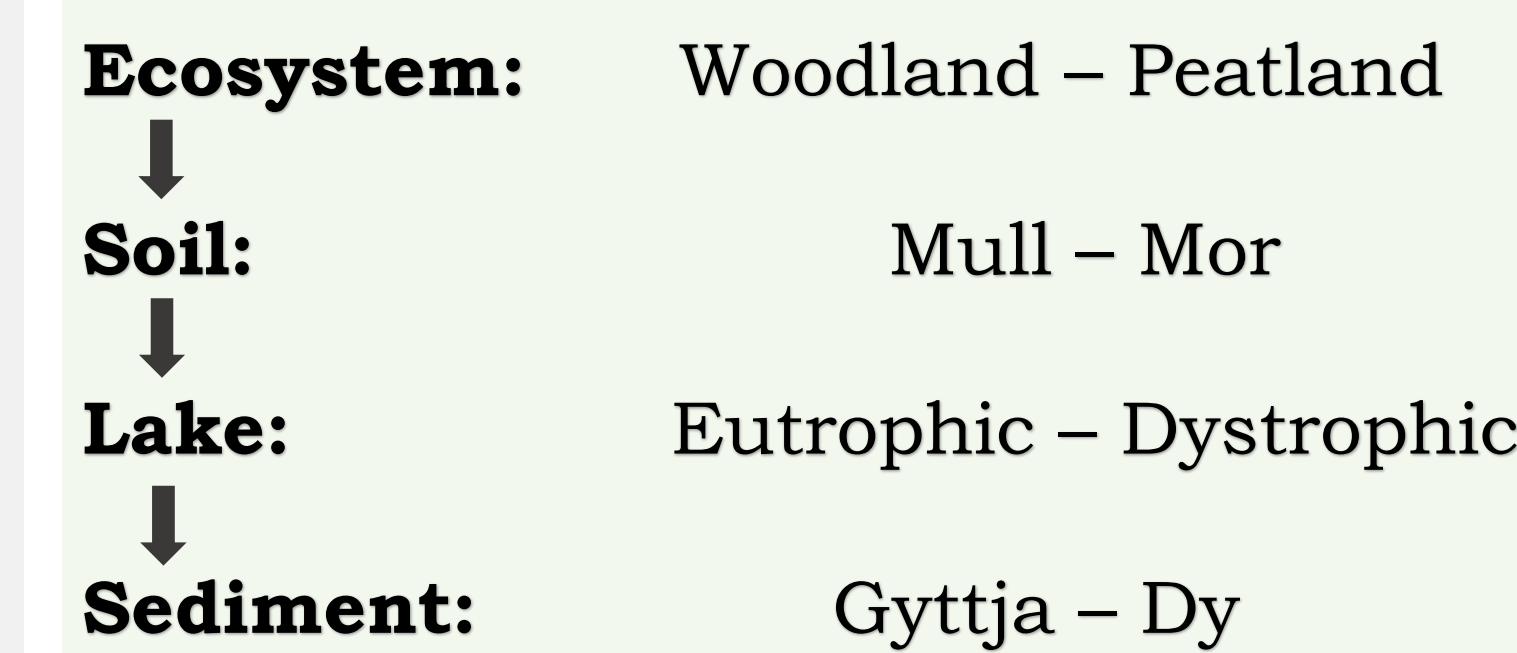
**II: mid** – Cyclic deposition. Low carbon deposition. Diatom blooms. Vivianite formation (P)

**III: early** – Low energy, deep water. Very low organic deposition. High minerogenic input.

## Implications

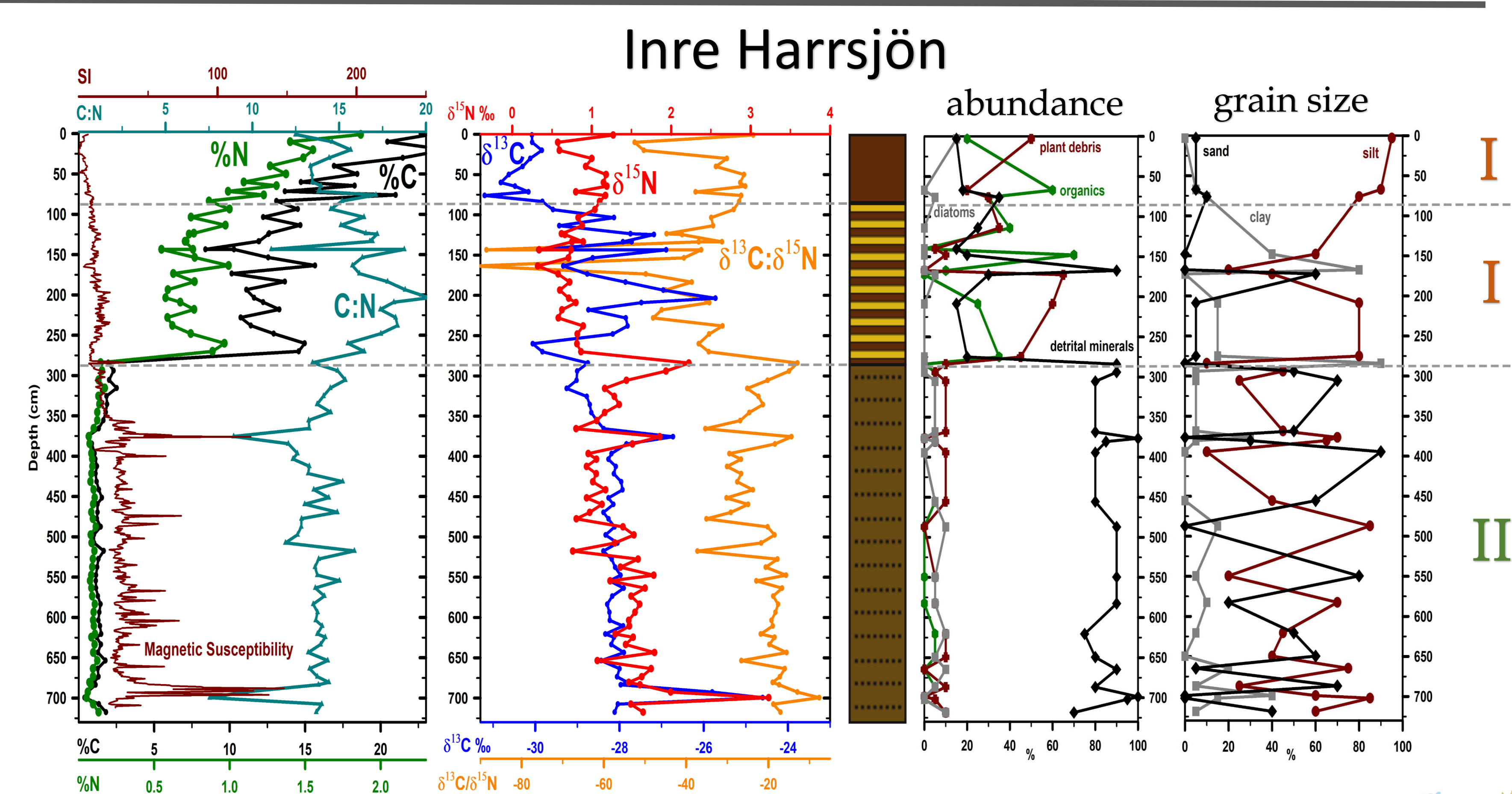
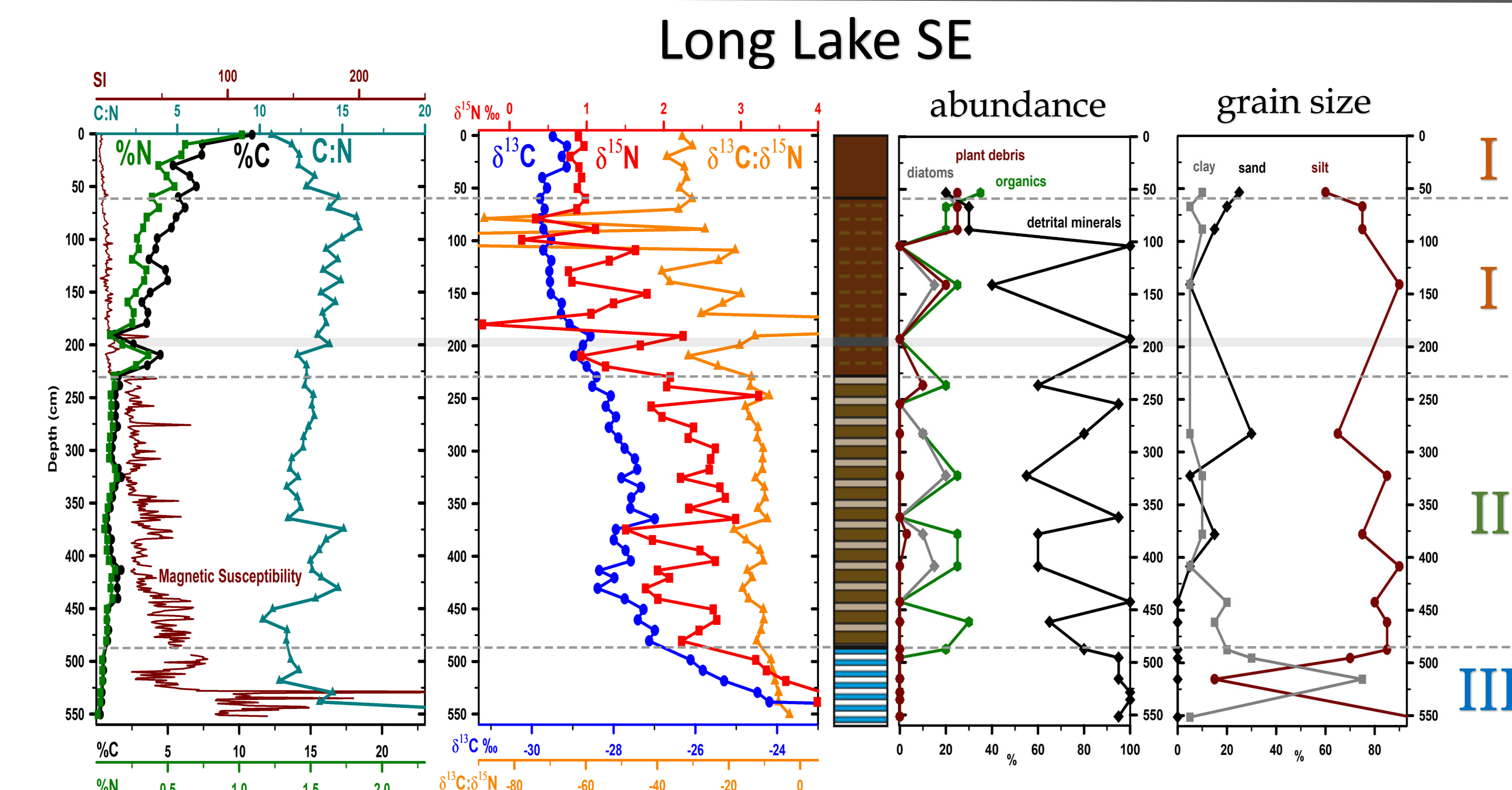
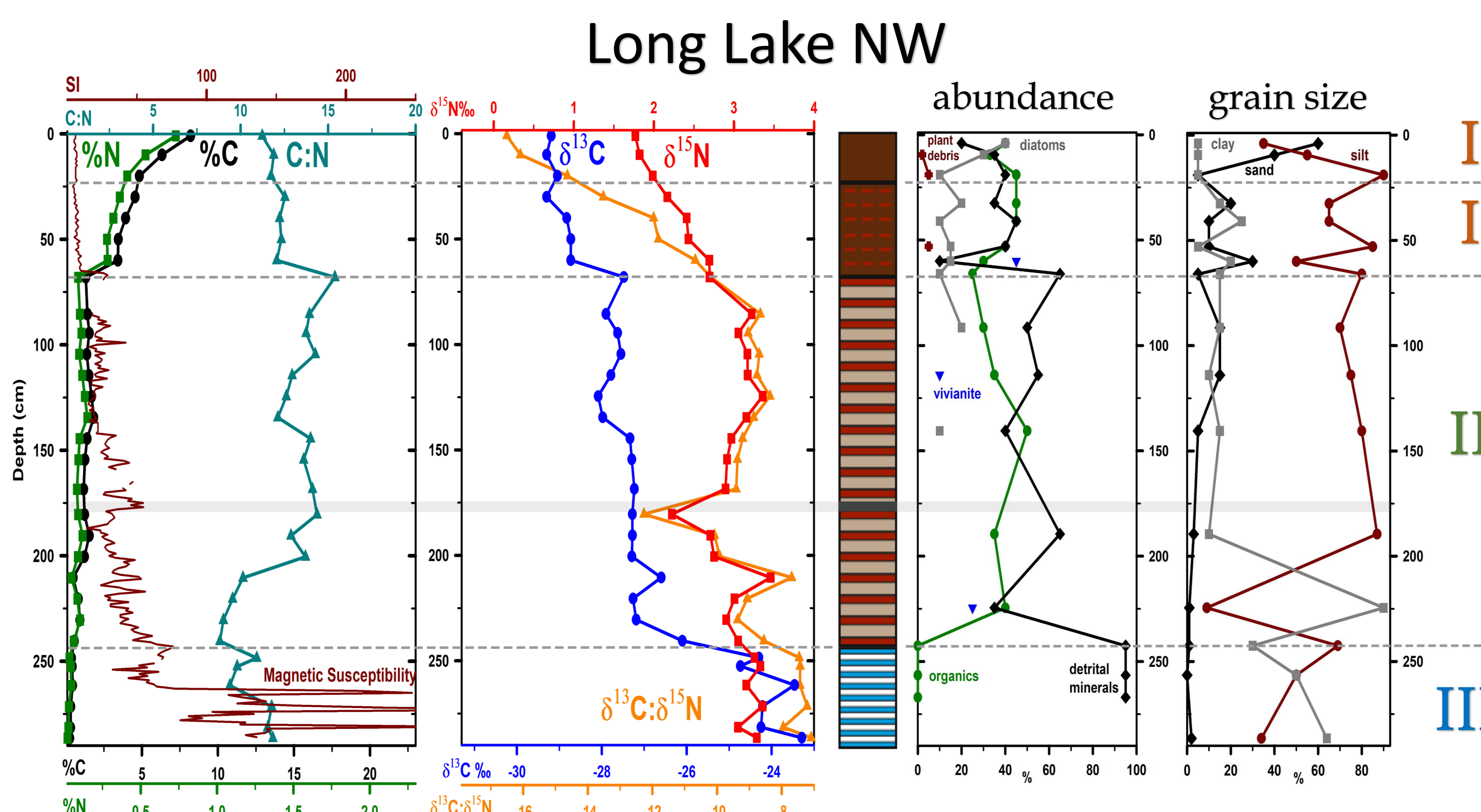
- Early Holocene clay confirms a significantly higher Tornetrask lake level during deglaciation (250m)<sup>5</sup>.
- Strong laminations during middle Holocene agree with a continental climate (strong seasonality).
- Late Holocene carbon accumulation reflects regional cooling and permafrost aggradation.
- A transition from Gytija to Dy at the onset of the late Holocene:
  - Reflects a change from eutrophic to dystrophic conditions
  - Caused by a shift from woodland to peatland catchment ecosystems
  - $\delta^{13}C$  and  $\delta^{15}N$  values show a gradual depletion from deglaciation to present day.

## Carbon Source



Stordalen Mire Vegetation and Plankton Values (Horrutiner, 2018):

	Plankton (n=2)	Aquatic Vegetation (n=8)	Terrestrial Vegetation (n=18)
C:N	5.7 ± 0.05	13.6 ± 1.5	30.8 ± 12.7
$\delta^{13}C$ (‰)	-31.6 ± 0.0	-24.95 ± 5.3	-28.1 ± 1.7
$\delta^{15}N$ (‰)	6.3 ± 2.5	2.7 ± 2.4	0.5 ± 2.0



1 - Berglund, B. E., Barnekow, L., Hammarlund, D., Sandgren, P., & Snowball, I. F. (1996). Holocene forest dynamics and climate changes in the Abisko area, northern Sweden: the Sessonson model of vegetation history reconsidered and confirmed. Ecological Bulletins, 15-30.  
 2 - Hansen, K. (1959). The terms gyttja and dy. Hydrobiologia, 13(4), 309-315.  
 3 - Horrutiner, 2018. Master's Thesis.  
 4 - Kokfelt, U., Reuss, N., Struyf, E., Sonesson, M., Rundgren, M., Skog, G., ... & Hammarlund, D. (2010). Wetland development, permafrost history and nutrient cycling inferred from late Holocene peat and lake sediment records in subarctic Sweden. Journal of Paleolimnology, 44(1), 327-342.  
 5 - Melander, O. (1977). Geomorphological map 304 Riksgården (east), 301 Abisko, 311 Reurivare and 311 Vadvetjåka. Description and assessment of areas of geomorphological importance. Report, Statens Naturvårdsverk (Swedish Environmental Protection Agency). SNV PM, 857, 56.

Thanks to Eric Heim for his excellent work in the field. Christina Herrick for her logistical advice and assistance. Andy Quimette for his isotope expertise and insight. Funding for this research was provided by UNH's Department of Earth Sciences student support fund and the Class of 1940 Professorship to R. Varner.