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RADIOCARBON AGES REFINE ICE SHEET RESPONSE DURING YOUNGER DRYAS IN NORTHERN NORWAY

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The prominent Tromsø–Lyngen moraines in northern Norway, part of a Scandinavia-wide moraine belt, are linked to a major re-advance of the Fennoscandian ice-sheet margin during the Younger Dryas. However, the timing and duration of the Tromsø–Lyngen event remain uncertain due to limited and sparsely distributed geochronological data.

To refine the temporal framework and assess the spatial variability of the Tromsø–Lyngen event, four proglacial threshold lakes were identified and cored. Proglacial threshold lake located distal to the moraine records minerogenic-rich clay accumulation during maximum ice re-advance, followed by a transition to organic-rich lacustrine or peat deposition upon ice-margin retreat (e.g., Dahl et al., 2003; Larocca and Axford, 2022). Targeted macrofossil sampling was conducted and radiocarbon dating was focused on the minerogenic–organic transition within the sediment cores, thus constraining the timing of the local ice-margin recession. Three radiocarbon samples were submitted for analysis under the QRA-funded 14CHRONO award (Table 1).

Dating lab ID	Dated material	14C age (a BP)
UBA-58843	Mix of seeds and leaf remains (mostly *Betula nana*)	10 801 ± 43
UBA-59998	Leaves (*Betula nana*)	10 018 ± 35
UBA-59999	Twig	9 157 ± 37

Table 1: Radiocarbon ages supported by the 14CHRONO award. Reported ages are given as 14C ages (a BP) with analytical uncertainty.

The four sediment cores show broadly similar stratigraphic successions (Fig. 1). In Holmvatnet and Bonnivannet, a clear transition occurs from glacial, minerogenic clay to overlying organic-rich, non-glacial sediments, coincident with higher loss-on-ignition (LOI) values. The Tromsøya core has a similar pattern, but its lowermost glacial unit is interpreted as recording the initial phase of the long-lived glacial re-advance and thus provides a minimum age for its onset. After this phase, the ice margin appears to have retreated sufficiently to stop the direct inflow of meltwater to the lake. In Ytre Eidasvannet, a lower core section comprises a coarser-grained unit with elevated LOI, interpreted as non-glacial input that may pre-date the re-advance and thus offers an additional minimum age constraint for its onset. Efforts to date the transition to overlying non-glacial sediments higher in the core may be unreliable because the dated material was aquatic submerged seeds, likely affected by dissolved inorganic carbon and producing anomalously old radiocarbon ages. This underscores the need to carefully select and evaluate dated macrofossils in carbonate-rich units in the vicinity of lake basins.

The new radiocarbon results offer a refinement of chronological precision and reveal a prolonged (≥ 1200 years) glacier re-advance and asynchronous glacier responses in the complex and heterogeneous landscape. It supports earlier evidence that the Tromsø–Lyngen event was initiated during the Late Allerød re-advance after a short period of largely ice-free fjords and that the ice margin then remained broadly stable through the Younger Dryas. Compared with similar ice-sheet re-advances in Scandinavia, this event is the longest documented period of stable

equilibrium. Furthermore, the refined chronology indicates an earlier and faster deglaciation in the western part of the study area at the Younger Dryas–Holocene transition, where the main marine-terminating outlet glaciers were located within steep-sided fjord systems. In the eastern part, by contrast, it indicates a longer-lived ice margin into the Early Holocene across extensive high plateaus lacking large marine-terminating outlet glaciers.

These spatially variable patterns show that the re-advance cannot be explained by external climate forcing alone, emphasizing the role of internal ice-sheet dynamics and local topography in controlling ice-margin oscillations, while still reflecting the dominant influence of Late Glacial–Early Holocene climate change.

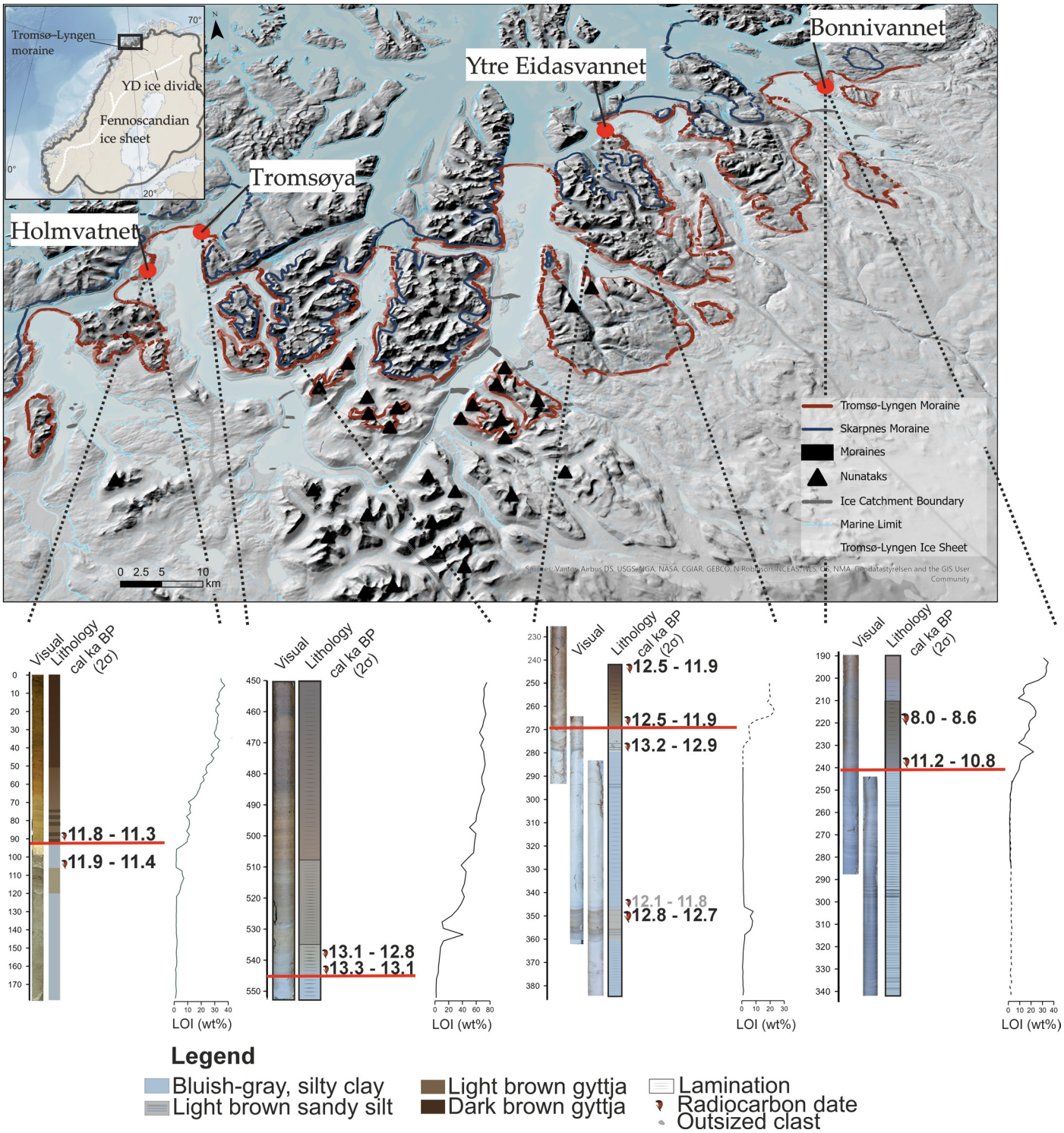


Figure 1: *Upper part:* Overview map showing ice sheet extent of Fennoscandian ice sheet during 12.0 cal ka BP based on Hughes et al. (2016). Main map shows digital elevation map of the study area showing the moraines and study sites. Light blue line shows Marine Limit (NGU). *Lower part:* Stratigraphic log with core image, lithology, calibrated 2σ age range and LOI. Red lines indicate interpreted change from glacial to non-glacial sediments.

References

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