EGU21-11494, updated on 05 Dec 2022
https://doi.org/10.5194/egusphere-egu21-11494
EGU General Assembly 2021


# The transition from the Late Glacial to the Early Holocene and its expression in moraine records of the Silvretta Massif

**Sandra M. Braumann**[1,2], Joerg M. Schaefer[2], Stephanie M. Neuhuber[1], and Markus Fiebig[1]
[1]Insitute of Applied Geology, BOKU University, Vienna, Austria
[2]Division of Geochemistry, Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY, USA

Mountain glaciers and their preserved moraine records provide important insights into periods when climate conditions favored glacier advance or stabilization. Comprehensive mapping of moraines in glacier forefields elucidates the *spatial distribution* of former ice margins. Numerical age dating of moraines, in turn, constrains the *timing* of moraine formation intervals. A combination of both methods allows reconstructing the evolution of mountain glaciers across time and space and links today's alpine geomorphology with climate of the past.

Here, we present glacier reconstructions from two adjacent valleys in the northern Silvretta Massif (Austrian Alps). Both, the Jamtal and the Laraintal, exhibit multiple prominent moraine ridges outboard the Little Ice Age (LIA) moraine and inboard presumable Late Glacial ice margins. By applying $^{10}$Be surface exposure dating to these moraines, we decipher the response of Silvretta glaciers to the transition from glacial to interglacial climatic conditions.

Pronounced double-ridge structures in lateral and terminal positions outside the LIA moraines were dated and yield landform ages of 11.3 ±0.8 kyrs (n=12) and 10.8 ±0.8 kyrs (n=9). This age pattern is consistent across both valleys and implies two significant moraine formation intervals during the earliest Holocene that overlap within uncertainties. Additional samples (n=6) were collected along presumable LIA ice margins. Four of them indeed produced LIA ages with three of them suggesting a culmination in the second half of the 18$^{th}$ century CE (mean age: 260 ±25 yrs). This result is in good agreement with $^{10}$Be ages from a recent study at an adjacent site, which indicate a LIA advance around 260 ±30 yrs. The remaining two ages coincide with a phase of cooler temperatures and increased precipitation in Europe from the 4$^{th}$ to 6$^{th}$ century, a climate episode, which is often associated with the fall of the Roman Empire and with the migration period in Europe.

We interpret the sets of Early Holocene moraines as evidence of brief cold lapses, which punctuated the general warming trend at the beginning of the Holocene, with the Preboreal Oscillation (PBO; c. 11,300 to 11,150 cal BP) being the most prominent one. Moraine formation intervals during the Early Holocene have been reported in the wider Alpine region and at other places in the northern hemisphere (e.g. North America, Scandinavia, Greenland). Annual mean temperatures certainly differed at each of these places, but synchronous phases of glacier advances or stabilization are recorded across the northern hemisphere during the Early Holocene.

We suggest that freshwater input into the Atlantic Ocean caused phases of temporary weakening of the Atlantic Meridional Overturning Circulation (AMOC), which lead to episodes of relative cooling in the northern hemisphere. This cooling phases are preserved in the Early Holocene moraine sets that we mapped and dated in the Silvretta region.