Post-LGM Glacier Fluctuations in the northern Valaisian Alps

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Introduction

The northern Valaisian Alps are covered by several glaciers nowadays. The landscape here is glacially overprinted and often contains well-preserved moraines that were formed by the post-LGM (Last Glacial Maximum) glacier advances. The presence of moraines rises the following questions: *When and how large were the northern Valaisian glaciers during the post-LGM?* and *which climatic deteriorations caused the fluctuations of these glaciers?* To answer these, the focus is put on the reconstruction of the post-LGM glacier evolution in two of the northern tributary valleys (Belalp and Lüsgenalp) of the Great Aletsch glacier (Fig.1).

Study site

The study area is located at an altitude between 2100 and 2700 m a.s.l, and covers ca. 9 km^2. The Quaternary sediments overly the crystalline rocks of the Aar Massif, which is a part of the Helvetic Tectonic Unit (Figs.1 and 2).

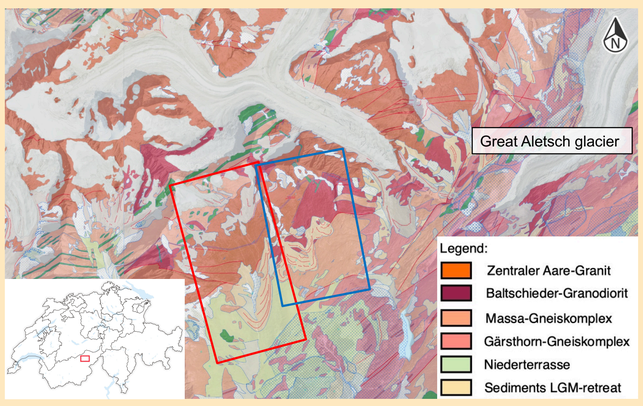


Fig.1: G*eological map of the study region* (map.geo.admin.ch). *The red and blue rectangles show the extend of the figures 6 and 7.*

Fig.2: *Picture of the Lüsgenalp and Belalp valleys taken by Unmanned Air Vehicle (UAV). View towards north.*

Methods

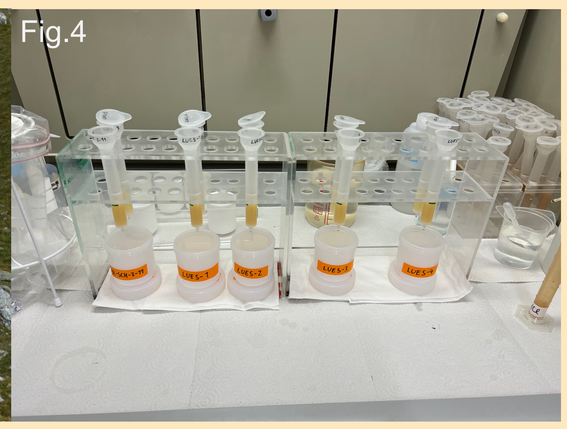


Fig.3: B*oulder LUES-1 sampled for surface exposure dating with the cosmogenic nuclide ^{10}Be in Lüsgenalp. This boulder is located on the crestline of the outermost left lateral moraine (Fig.7 for details).*

Fig.4: *Anion column step of the sample preparation for cosmogenic ^{10}Be analysis.*

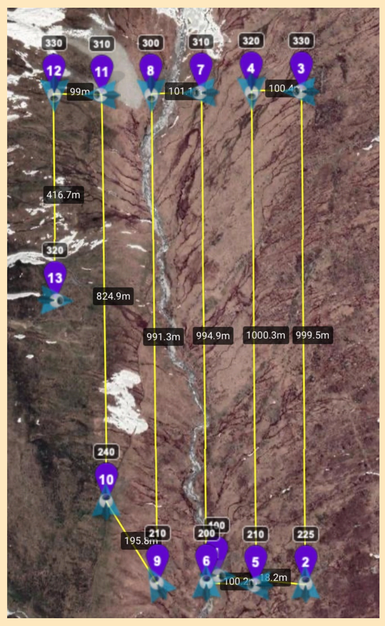


Fig.5: *Route of the 3rd UAV flight mission. 9 missions in total were employed to take high resolution aerial photographs.*

Photogrammetry with Agisoft Metashape®

- UAV missions, high resolution pictures (Fig.5)
- Orthoimage
- Digital Elevation Model (DEM), 6 cm/pixel

Mapping on QGIS®

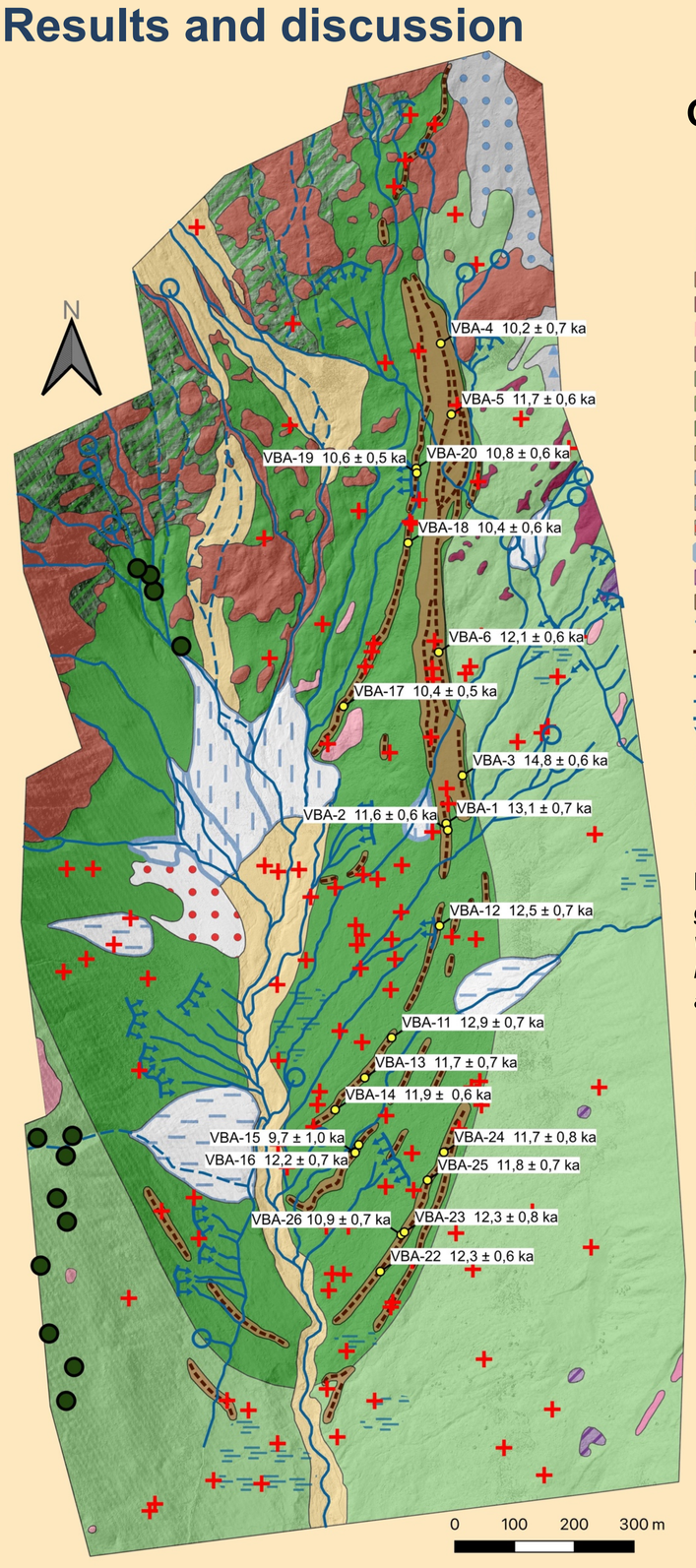
- Detailed geological and geomorphological mapping of the Belalp and Lüsgenalp valleys (Fig.6)
- Red Relief Image (Fig.7)

Surface exposure dating with ^{10}Be

- 14 Samples at Lüsgenalp (Figs.3 and 4)
- 21 exposure ages by Schindelwig et al. (2012)

Glacial modelling

Results and discussion



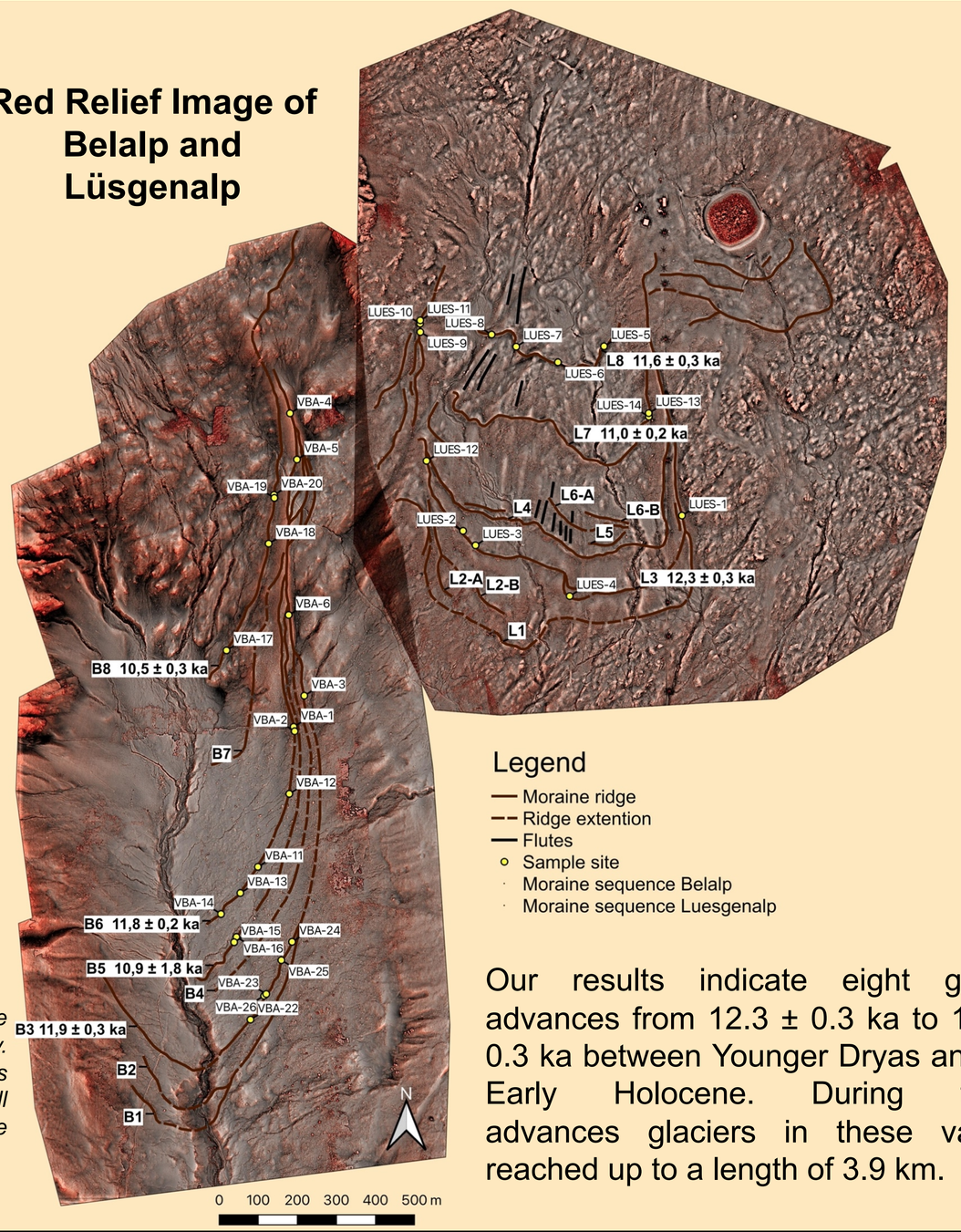
Geological map of Belalp

Legend

- Central Aare Granite
- Baltschieder Granodiorite
- Massa Gneiss Complex
- Gaersthorn Gneiss Complex
- Till (Older)
- Rock under thin layer off Till
- Till (Younger Dryas and younger)
- Glaciofluvial deposits
- Stone run
- Slope deposits
- Schneehalden Moräne
- Alluvial fan
- Human impact
- Moraine
- Swamp
- Moraine ridge
- Stream
- Ephemeral stream
- Spring horizon
- Erratic boulder
- Spring
- Till outcrop
- Sample site and age

Fig.6: *Detailed geological and geomorphological map of Belalp valley. Surface exposure ages recalculated from Schindelwig et al. (2012) are indicated.*

Red Relief Image of Belalp and Lüsgenalp



Legend

- Moraine ridge
- Ridge extention
- Flutes
- Sample site
- Moraine sequence Belalp
- Moraine sequence Luesgenalp

Fig.7: *Red Relief map of the Belalp and Lüsgenalp valley. Glacial landforms such as moraines and flutes, as well as the calculated ages of the moraines are indicated.*

Our results indicate eight glacier advances from 12.3 ± 0.3 ka to 10.5 ± 0.3 ka between Younger Dryas and the Early Holocene. During these advances glaciers in these valleys reached up to a length of 3.9 km.

Outlook

- Modeling of the paleoglaciers of Belalp and Lüsgenalp using Glare® and ELA® (toolboxes of ArcGIS®) to determine the equilibrium line altitudes and thus to calculate the paleotemperatures.
- Regional paleoclimatic conditions of the northern Valaisian Alps will be reconstructed by comparing our results with the existing climate proxies in the Alps.

References

https://map.geo.admin.ch/?lang=de&topic=geol&bgLayer=ch.swisstopo.pixelkarte-grau&layers=ch.swisstopo.geologie-geocover&layers_opacity=0.75

Schindelwig, I. *et al.* (2012) 'Lateglacial and early Holocene dynamics of adjacent valley glaciers in the Western Swiss Alps', *Journal of Quaternary Science*, 27(1), pp. 114–124. doi: 10.1002/jqs.1523.