Understanding the process forming subglacial overdeepenings: The Rhone Glacier Lake example

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qPAL Quaternary Geology and Paleoclimatology

Introduction

Unterstanding processes such as overdeepenings are important, but the clarity is mostly hidden in the subsurface (Magrani et al., 2020). In general the reconstruction of landscapes formed by glaciation is very complex and rather challenging (Büchi et al., 2018). Because of this poor understanding, we try to comprehend the process in more details.

Aim of the study

- How does an overdeepened basin look like?
- How does very young overdeepened till looks like?
- Whats the ratio of sedimentation to erosion?
- Reconstruction of the melted glacierfront with subaquatic moraines

Study site

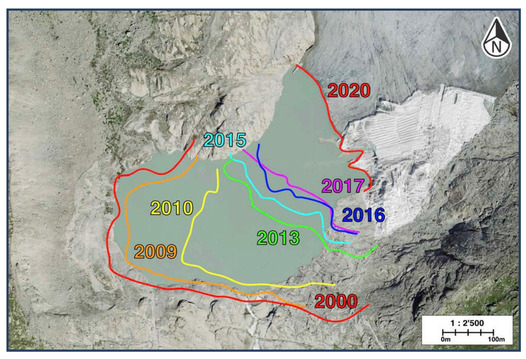

Fig. 1: Retreat of the Rhone Glacier since the year 2000 (edited, ©swisstopo)

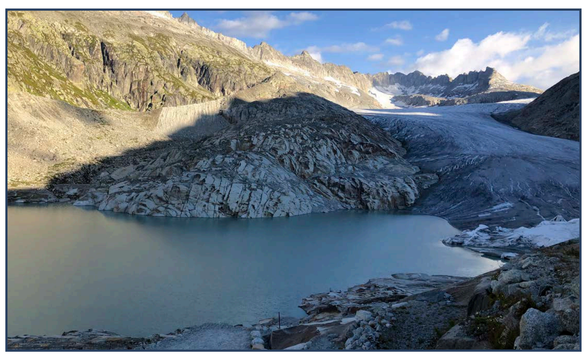

Fig. 2: Outlook to the study site

- Proglacial lake of the Rhone Glacier, canton of Valais, Switzerland
- Was built due to meltwater and spring inflow into an subglacial overdeepening
- Fast melting leads to a very young proglacial lake
- Same lake was already measured in 2015, since then the size increased to the double

Methods

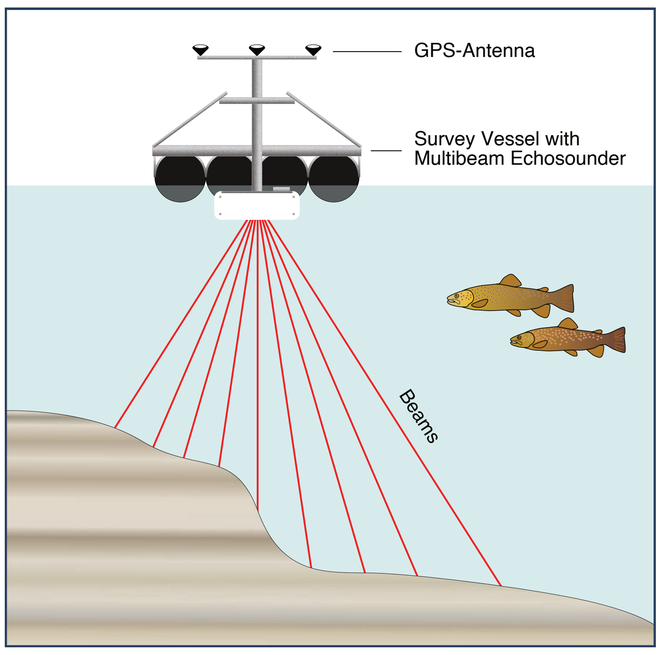

Fig. 3: Survey platform with attached Multibeam Echosounder

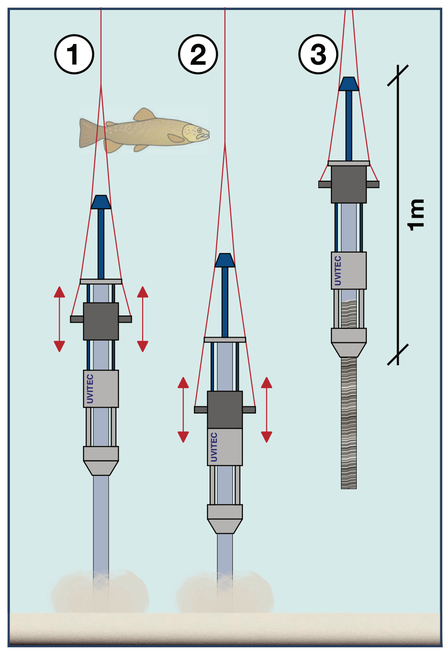

Fig. 4: Uvitec coring device, the weight (dark grey) gets pulled up by hand, releasing the weight the plastic liner plunges into the sediments

Bathymetry

- Use of a Multibeam Echosounder to create a bathymetric map (Fig. 3)
- With help of the bathymetric map we get knowledge about depths, bottom density and the diffrence compared to 2015

Coring

- Use of a handcorer (Fig. 4) with plastic liners to take short cores of glacial sediments

Radardata

- Analysis of radar data (by A. Bauder) of the bottom of the Rhone Glacier

Results

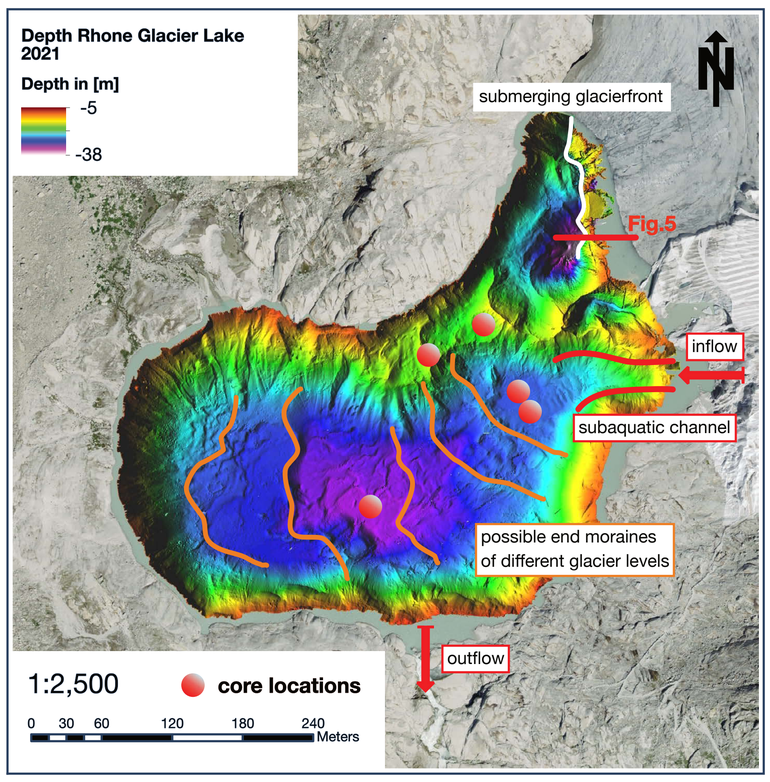

Fig. 4: Interpreted bathymetric map with the water depth of the Rhone Glacier Lake in 2021

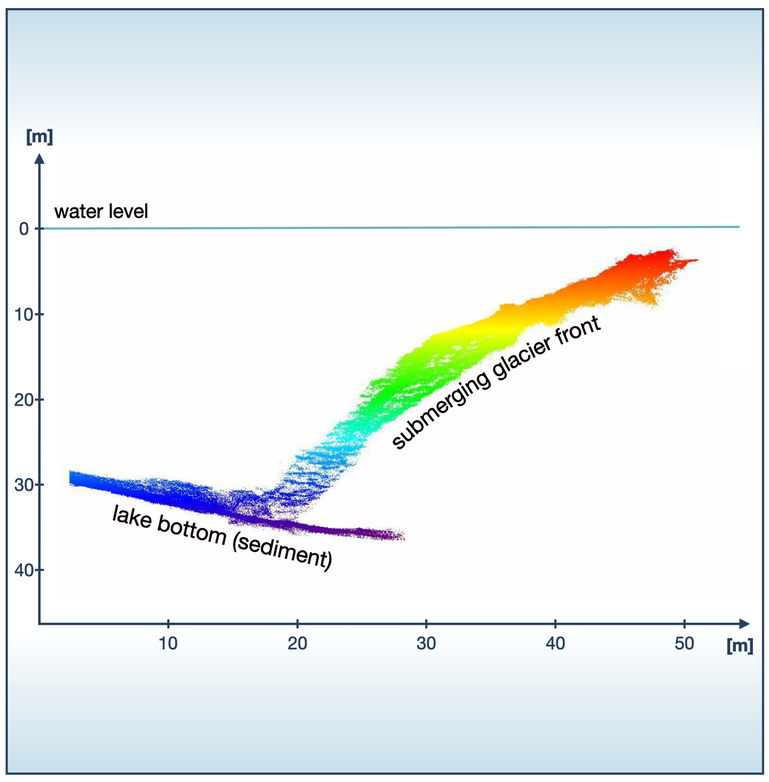

Fig. 5: Point cloud of the detected submerging glacierfront (see also Fig. 4)

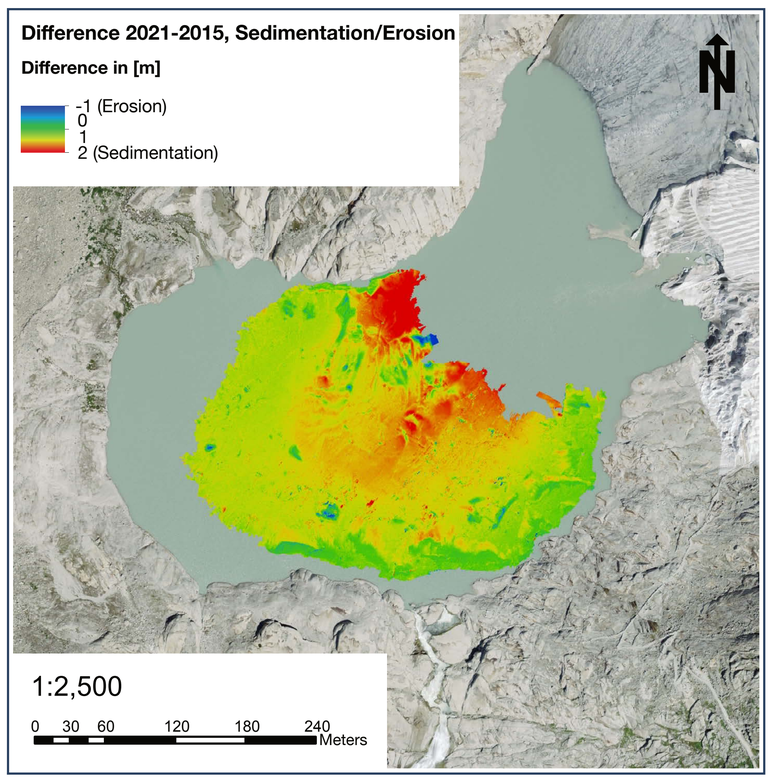

Fig. 6: Sedimention/erosion diffrence map, datasets compared from 2015 and 2021. Positive values mean sedimentation, negative (blueish) erosion.

- In the bathymetric map we can see several geomorphical features that shows the glacier retreat
- The interpreted end moraines are very likely correlating with the retreat shown in Figure 1
- The main inflow from the eastern side built a subaquatic channel

- In the point cloud one can see that the bottom of the lake is going further down, means the overdeepening of this part goes downwards even more under the glacier front
- The bathymetric data shows a pretty good image of the submerging glacierfront
- Possible sedimentation over the glacier front at some parts

- The diffrence map shows a comparison of 2015 and 2021, related to the sedimentation and erosion
- Almost everywhere deposition, mostly in the main overdeepening in the middle of the lake
- Less sedimentation because of the outflow in the south, where finegrained sediments get carried away

Conclusion

- Different standings of the glacier can be detected, also compared the retreat (see Fig. 1)
- Glacier is forming generally one main overdeepening, but within many small ones, as one can see at the northern tip of the lake, where (compared to 2015) occurs a new deepest part of the lake
- Despite the high density of the till, short cores could be retrieved

Outlook

- Analysis of the cores; making a logsheet
- Get in touch with the correlation of the glacier levels and the sedimentation (with the use of the diffrence map)
- Comparison with the radar data of the glacier bottom

References

Buechi, M.W., Graf, H., Haldimann, P. *et al.* Multiple Quaternary erosion and infill cycles in overdeepened basins of the northern Alpine foreland. *Swiss J Geosci* 111, 133–167 (2018). https://doi.org/10.1007/s00015-017-0289-9

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