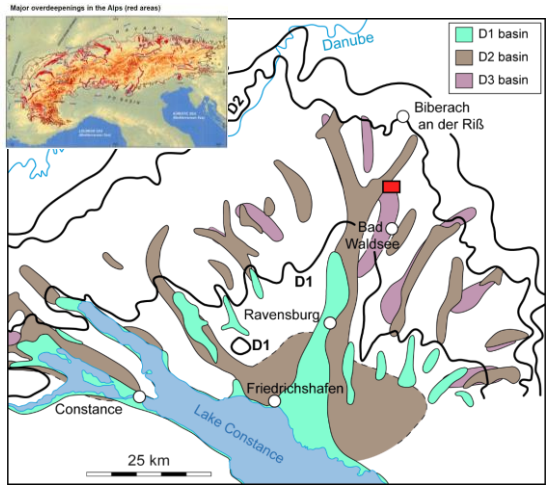
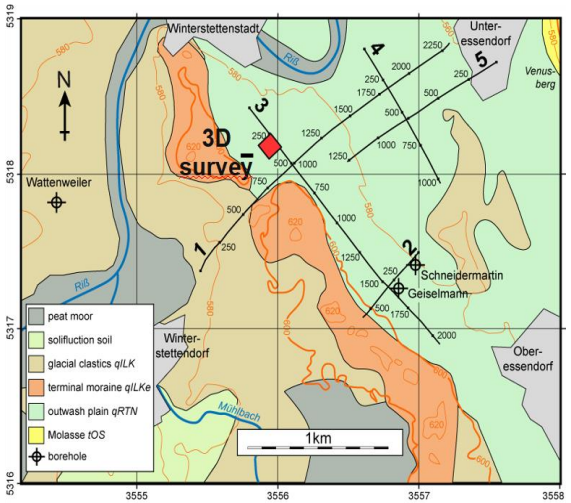
Near-surface glaciotectonic structures in the sediments of an overdeepened glacial valley revealed by a shallow 3D seismic survey

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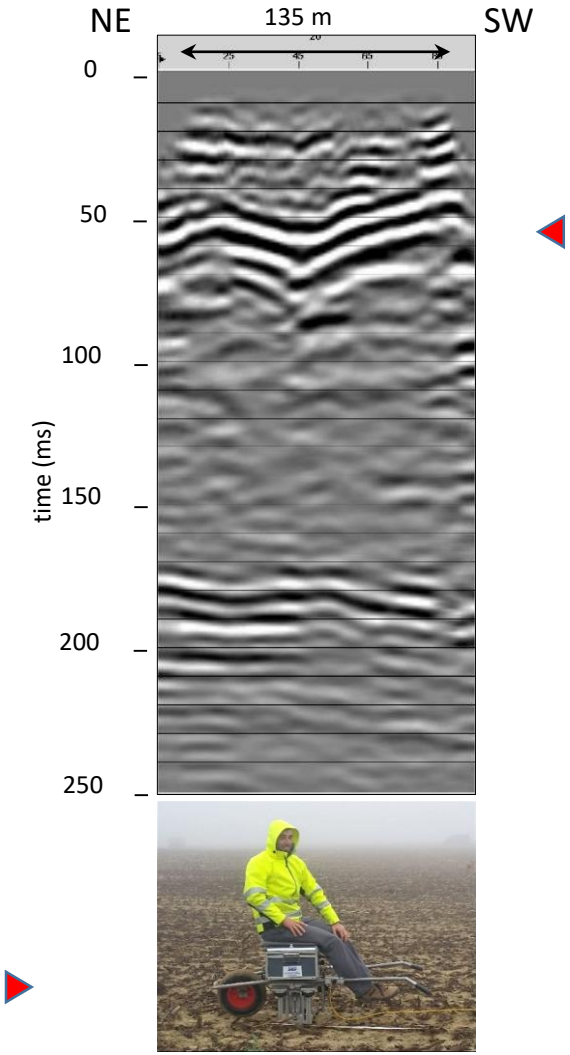


Motivation & Geology

Overdeepened valleys caused by glaciers are present around the whole Alpine region, but very little is known about their timing, geometry, and under which climatic conditions they were created.

On the north side of the Alps, the Rhine glacier system stretches from Lake Constance in the south to Biberach in the north. We investigate the Tannwald Basin (red square).

Locally, an overdeepened valley (green colours) of Rissian and Hosskirchian age is overlain to the west by a large terminal moraine body of the LGM (latest Würmian; orange colour). With a net of P-wave seismics (black lines) we determined the shape of the overdeepened valley and found an appropriate drill site. At the drill site, we conducted a very detailed, 3-D, 120 x 120 m², P-wave seismic reflection survey around it, using our own small seismic source (ELVIS).



Results & Conclusions

The figure left shows inline 20 after prestack time migration.

The lower reflections at 180 ms represent the base of the overdeepened valley.

The upper reflections at 50-70 ms are from a prominent till horizon, capped by coarse clastics. Below the till are fine basin facies.

Clearly the till is folded; this is a cuspate-lobate fold. Cuspate-lobate folding is typical for deformation of layers of differing mechanical competence (after Ramsay and Huber 1987; µ1/µ2 less than 10).

From the strike of the fold (WNW-ESE), we hypothesis that the fold was generated by the Würmian push moraine from the SW.

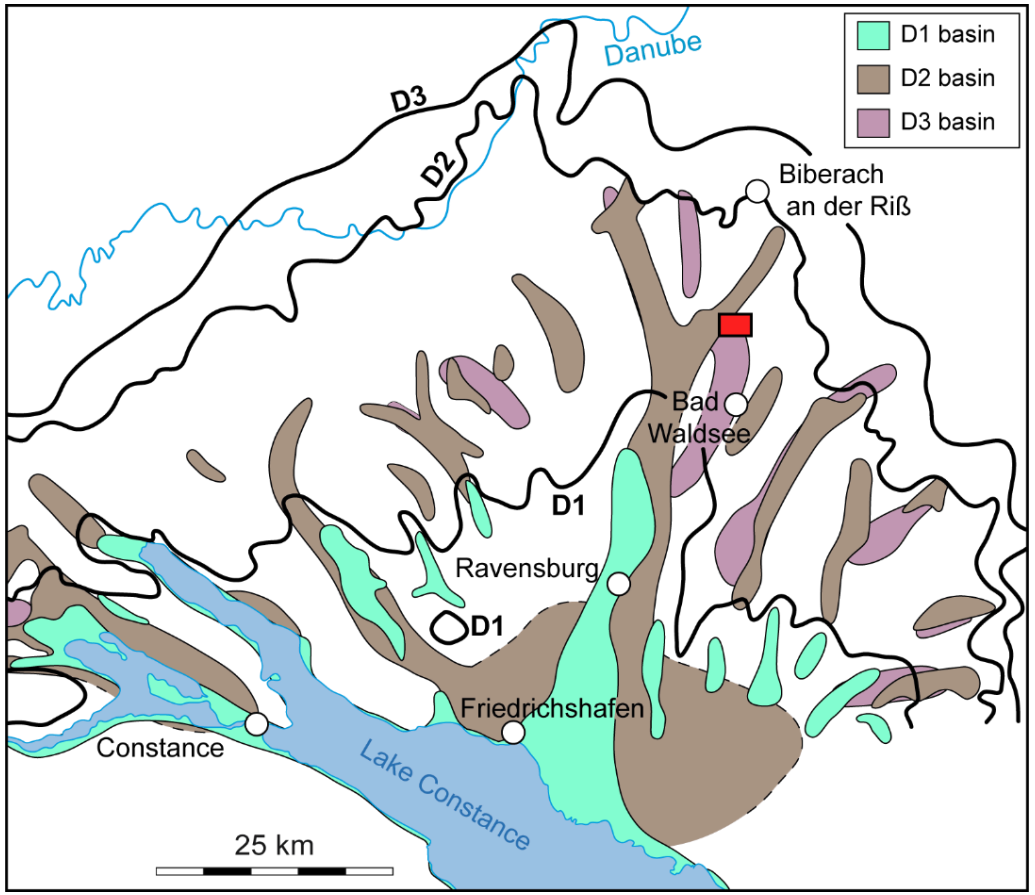
Ramsay, J.G. and Huber, M. I. (1987): The techniques of modern structural geology.

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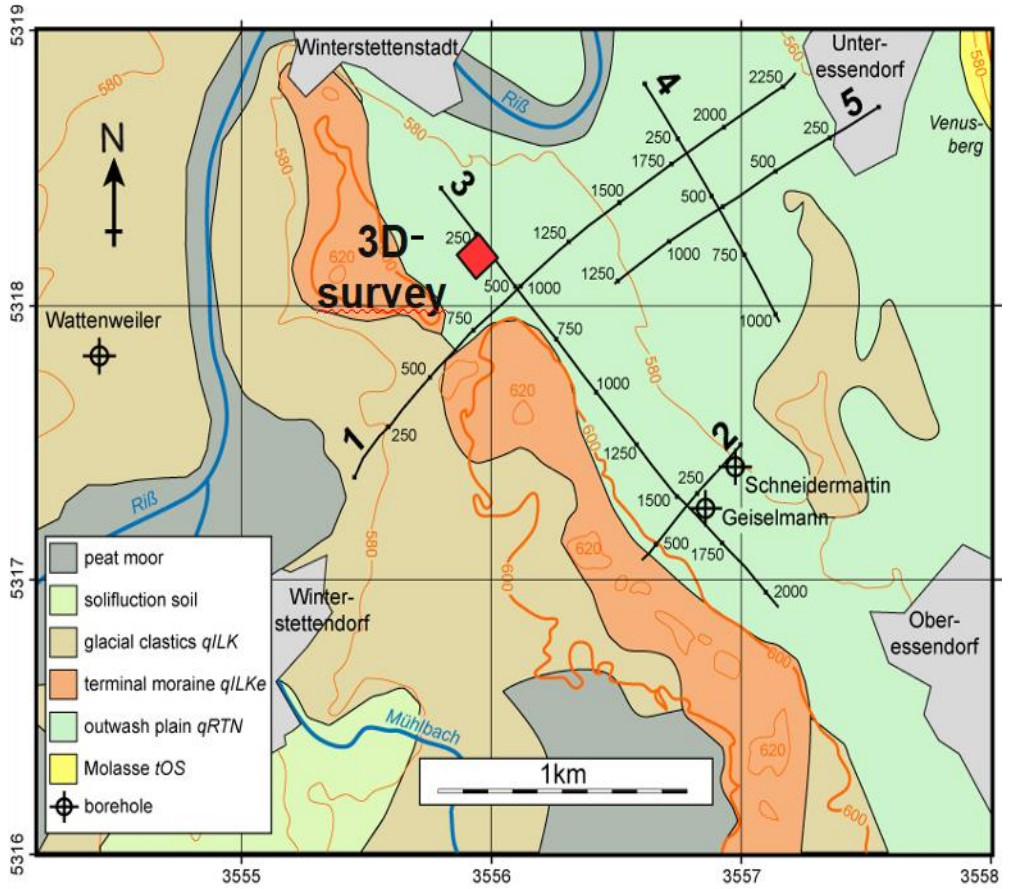
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Overview of the Rhine Glacier sediments



Local geology. Note the position of the seismic (red square) to the terminal moraine body.

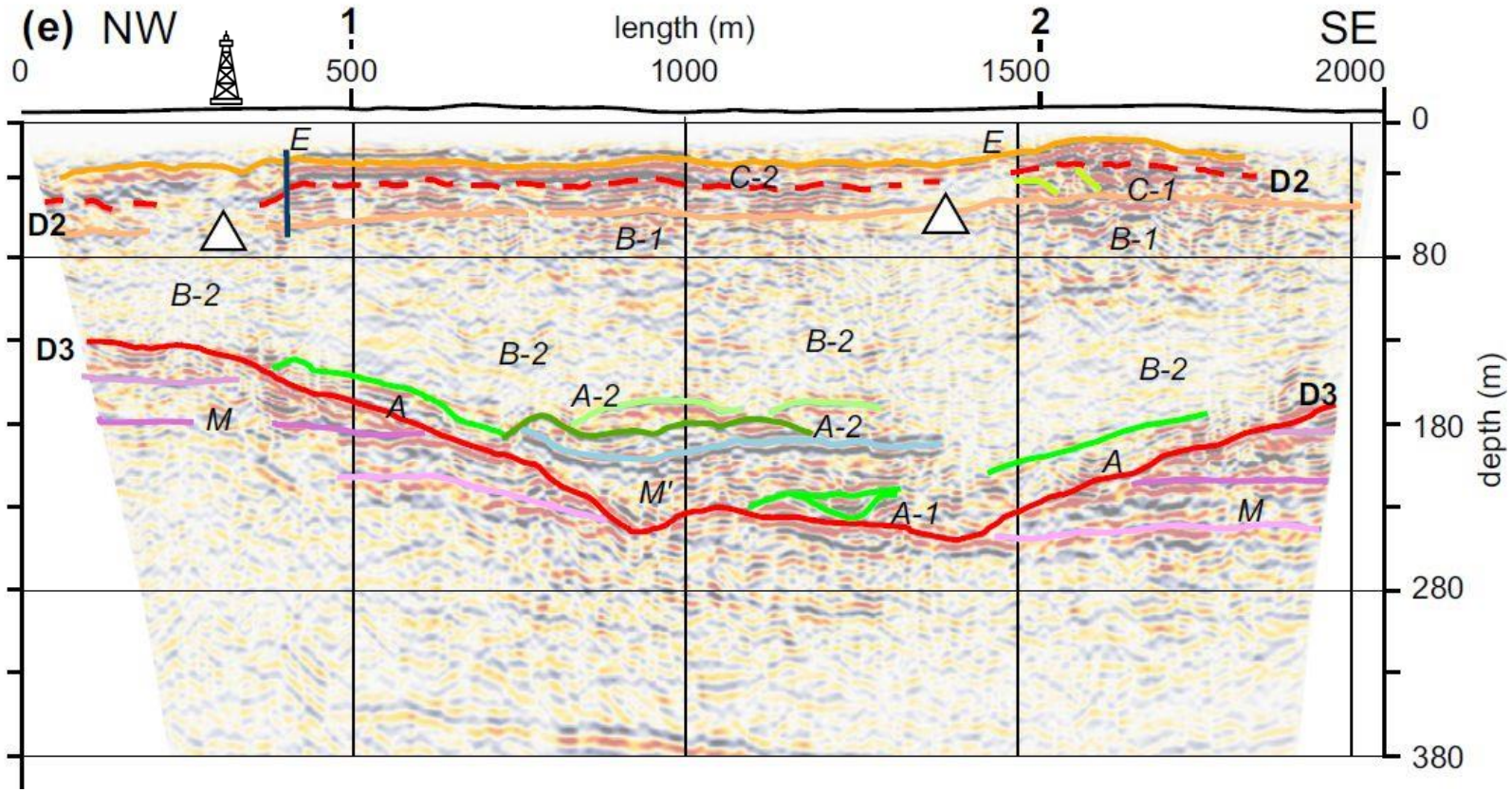
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P-wave cross-section of the overdeepened Tannwald Basin valley. See key for details. [from Burschil et al. https://doi.org/10.1002/nsg.12011]

The drill site is situated on the west flank of the valley.



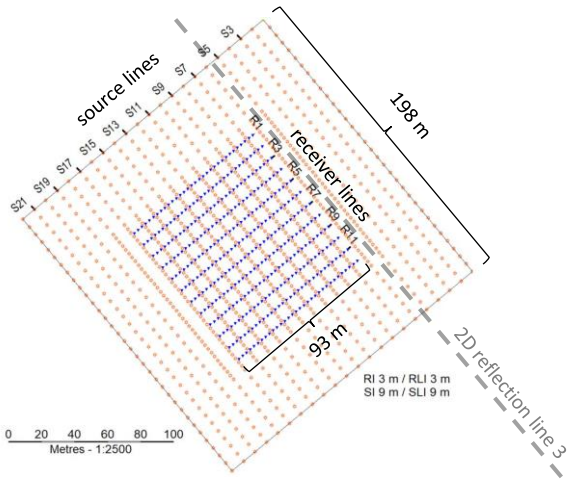
M Upper Freshwater Molasse (*tOS)*, M' allochthonous molasse slab, Lodgement till, A-1 trough structure, A-2 esker, B Basinal fine-grained deposits (Dietmanns basin
Sediment), B-1 B-2, C Till sequences and till, C-1 Scholterhaus Sfm., C-2Duermentingen Sfm, E Fluvial deposits, sand/gravel, outwash plains, D3 and D2 regional unconformities separating major deposition/erosion cycles occurring in mid-Hoßkirchian resp. mid-Rissian glacial period.

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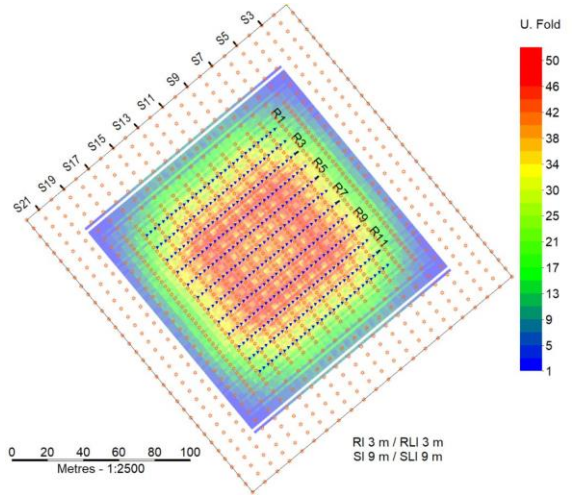
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a.)



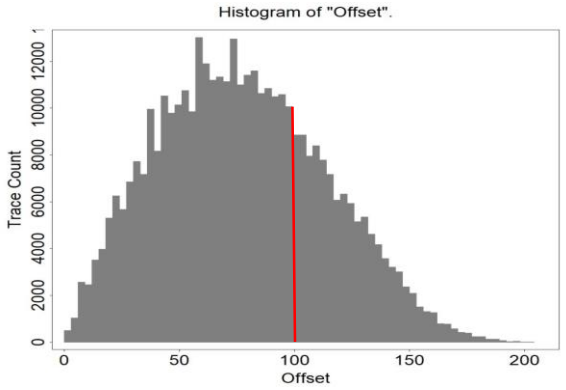
b.)



Details of the 3-D aquisition

Layout of 3-D survey (a) source and receiver lines, (b) unique fold using an offset bin size of 3m, (c) offset distribution of all traces, the red line indicates the required minimal maximum offset of 100 m.

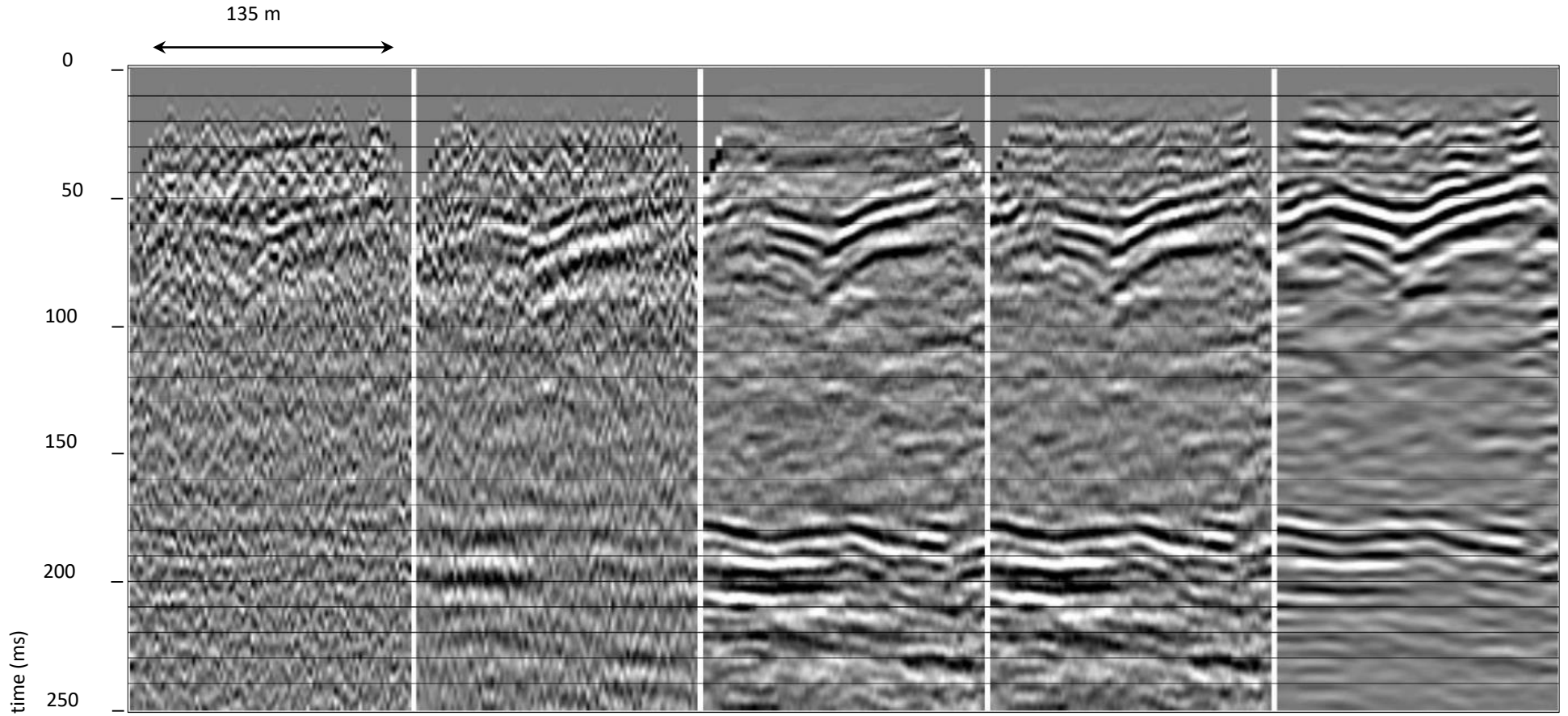
c.)



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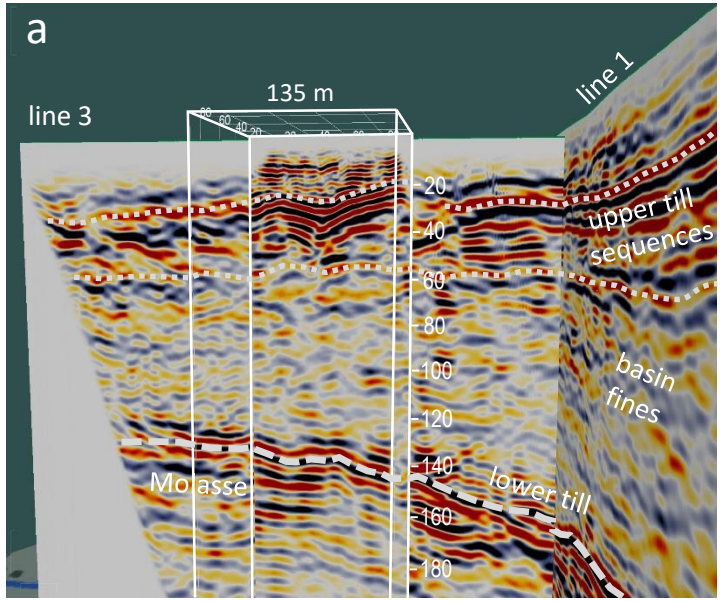


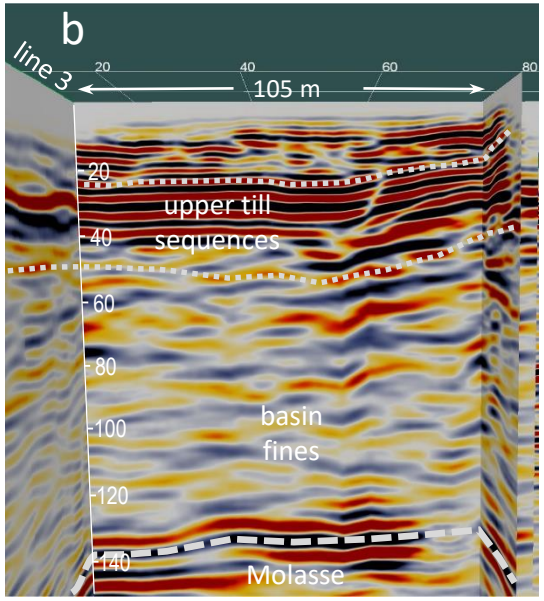
Inline 20 stacked with (a) standard prestack processing (steps 1-6 in tab. 2), (b) additional 3-D f-k filter, (c) CRS regularization, (d) additional f-k filter, (e) additional prestack time migration

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3D volume and 2D lines:

(a) inline 20 and 2D profiles 3 and 1. The inline runs parallel 15 m in front of line 3 and shows cuspate-lobate folding in the upper till sequences. The 2D lines and the interpretation is adapted from Burschil et al. (2018).

(b) xline 39 showing a fault propagating fault in the upper till sequence. Note the better resolution of the 3D volume compared to the 2D lines. The actual surface is from 8-10 m above reference datum.

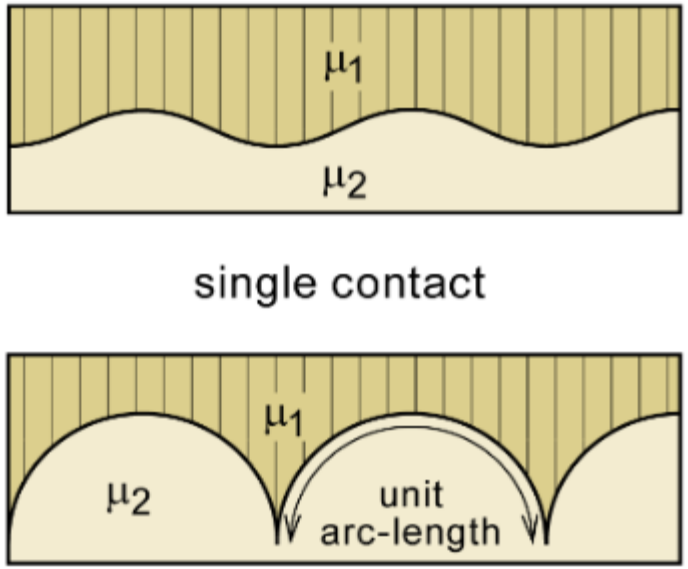
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Cuspate-lobate folding above the Glarus Thrust. Photo Jonas Ruh



Cuspate-lobate folding (figure from J-P Brunn, ETH Zürich).