Recent developments of seismic exploration in the Tannwald Basin

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Introduction

Overdeepened valleys and basins mark prominent settlement areas in the European Alps. These Quaternary structures were primarily carved out by glaciers (Fig. 1) and often refilled with deposits of different facies environments.

The ICDP proposal DOVE (Drilling Overdeepened Alpine Valleys; Fig. 2; ANSELMETTI et al., 2016) intends to investigate their sediment succession with respect to, e.g., glacial cycles and extent, geohazards, and groundwater. Preparatory to DOVE, a DFG-funded project (start 12/2015) studies the benefit of modern multi-component reflection seismics to characterize the sediment succession of two overdeepened structures, the Tannwald Basin (Germany; Fig. 2) and the Lienz Basin (Austria).

Seismic exploration

- P-waves image the overdeepened structure of the Tannwald Basin (Fig. 3). The nearby research borehole (Fig. 4) facilitates a preliminary interpretation.
- Different facies are distinguishable in the glacial sediment succession.
- SH-waves reveal the same overall structure of the Tannwald Basin (Fig. 5).
- SH-waves partially image structures in areas transparent for P-waves and show more details in some structures.
- P-wave seisms show a more coherent image and higher penetration depth, while SH-wave seismics resolves more details of some of the imaged structures. The combination enables an improved imaging to investigate the sedimentary succession in preparation for scientific drilling.

Results

- Revised data processing of P-wave and SH-wave profiles (e.g. PSDM for SH-waves).
- Processing of crosslines for 3D imaging to detect morphology of the erosion surface.
- Analysis of recorded multi-component data with respect to, e.g., anisotropy caused by tectonic and glacial loads.
- Refraction tomography to gain elastic parameters (Bachelor thesis in progress).
- Reflection seismic exploration in the Lienz Basin. Two campaigns, comprising P-waves, SH-waves, and multi-components, are scheduled for summer 2016.

Outlook

References


Fig. 1: Glacial overdeepening (after ANSELMETTI et al., 2016). a) A river erodes a non-glaciated landscape to the fluvial base level. b) Glacial erosion may excavate deep valleys below the fluvial base level. c) The trough are either filled by glacial deposits, e.g. the Tannwald Basin, or remain unfilled in form of lakes, e.g. Lake Constance.

Fig. 2: Suggested DOVE drilling sites. Major overdeepened valleys and basins (red), major catchment areas and ice stream directions (blue) (after PROSSER et al., 2010). Multi-component seismic investigation sites: Tannwald Basin and Lienz Basin.

Fig. 3: P-wave PSDM of profile 1P: A preliminary interpretation is superimposed. Dashed lines mark uncertain interpretation. Prominent structures are visible in both P- and SH-wave reflections.

Fig. 4: Nearby cored research borehole Schneidermatt (LGRB), drilled 1993/94. Location is marked in Fig. 6.

Fig. 6: Geological map (LGRB) and location of seismic profiles and boreholes. The profiles intersect the terminal moraine of the Last Glacial Maximum (LGM). Recorded profiles:
- 5 P-wave reflection seismic profiles (blue)
- 2 SH-wave reflection seismic profiles (red)
- 1 multi-component reflection seismic profile (3X receivers, SH-SV-sources), not yet processed (yellow)