Crosshole seismic data at ICDP site 5068_1
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1. Licence

Data access is embargoed until 31 December 2025

2. Citation

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3. Data description

This seismic crosshole dataset was acquired in the context of the DOVE project (Drilling Overdeepened Alpine Valleys) at ICDP site 5068_1 (Tannwald Basin) to image the glacial sediments at sub-meter scale. It consists of the field data with geographical coordinates.

The project aims to investigate the landscape evolution in the Alpine region by drilling overdeepened valleys and analyzing the cores (DOVE-Phase 1 Scientific Team, Schaller et al., 2023, Schuster et al., 2024). At site 5068_1 (Tannwald Basin), three boreholes were drilled to a depth of about 160 m depth, reaching the bedrock. Boreholes 5068_1_A and 5068_1_B were flush drilling and borehole 5068_1_C was cored. In 2022, the boreholes were used to perform high-resolution crosshole seismic measurements in order to image the glacial sediments at sub-meter scale. This dataset consists of the seismic field data with geographical coordinates and is subdivided by

(1) the used source and receiver borehole equipment (P: sparker and 24-station hydrophone string, SV: vertically polarizing shear wave source and three-component geophone string with eight geophones, SH: horizontally polarizing shear wave source and three-component geophone string with eight geophones),
(2) the respective borehole plane (BA, BC, and AC), and
(3) the acquisition geometry (STRING, CIRCLE, LINE_BA, LINE_BC, LINE_AC).

The surface seismic data (CIRCLE, LINE_BA, LINE_BC, LINE_AC) was recorded by three-component geophones. The seismic data is provided in SEGY Rev. 1.0 format together with geometry files in csv-format.

3.1. Instrumentation

- Sparker source (SBS 42, rented from: Geotomographie GmbH)
- SV-source (BIS-SV (prototype), rented from: Geotomographie GmbH)
- SH-source (BIS-SH, rented from: Geotomographie GmbH)
- Impulse generator (IPG5000, rented from: Geotomographie GmbH)
- 24-channel hydrophone string (BHC5, rented from: Geotomographie GmbH)
- 8-station three-component geophone string (MBAS-A, rented from: Geotomographie GmbH)
- Three-component geophones (SM-6, Input/Output, Inc.)
- 24-channel geodes (Geode Ultra-Light Exploration Seismograph, Geometrics)
- Acquistion software (Seismodule Controller Software for StrataVisor NZ, Geode, and ES-3000 seismographs, Geometrics)

3.2. Data processing

The raw field data was converted from SEG2 to SEGY format using VISTA and sorted according to the receiver string layouts (1a to 2b / 3b, see also Table 1 and Table 2) in Shearwater's Reveal software. Afterwards, the geometry was assigned following the field notes, GPS, and tachymeter measurements, connecting FFID and CHANNEL to absolute and relative shot and receiver locations including the source and receiver orientation. Quality control led to some corrections in the geometry in the data headers. The data was then separated into the measurement geometries: STRING (crosshole), CIRCLE, and LINE_XX.

4. File description

The data is provided in SEGY Rev. 1.0 format and IBM float sample format.

A coordinate scalar of -10 in byte 71 is used to store the coordinates. For more precise coordinates we refer to the geometry files. The coordinate system is EPSG4647 ETRS89 / UTM zone 32N (zE-N).

In case of the data that was acquired with the polarizing shear wave sources, the source orientation can be found in the geometry files (*.csv). For the SH-source a positive sign indicates a northward shooting direction and a negative sign a southward shooting direction. For the SV-source a positive sign indicates a upward shooting direction and a negative sign a downward shooting direction.

The respective data component is defined in the header word Trace Identification Code (byte 29 as 16-bit int), where the following nomenclature was used: pressure = 1, vertical = 2, inline = 3, and crossline = 4. Receiver depths can be found in byte 65 (Receiver Water Depth) as 32-bit int.

4.1. File inventory

The data are provided as the following separate zip folders:

- **5068-002_Beraus-et-al_P**: seismic data acquired with sparker source between boreholes B and A (PlaneBA), B and C (PlaneBC), and A and C (PlaneAC) as subfolders.
- **5068-002_Beraus-et-al_SH:** seismic data acquired with horizontally polarizing shear wave source between boreholes B and C
- **5068-002_Beraus-et-al_SV**: seismic data acquired with vertically polarizing shear wave source between borehole B and C

4.1.1. Folder 5068-002_Beraus-et-al_P

Folder	*Subfolder*	*Subfolder*/fil	file
P	***PlaneAC***	***geometry***	P_AC_FFID_SRC_COORD_SRC_DEPTH_1a.csv
			P_AC_FFID_SRC_COORD_SRC_DEPTH_1b.csv
			P_AC_FFID_SRC_COORD_SRC_DEPTH_2a.csv
			P_AC_FFID_SRC_COORD_SRC_DEPTH_2b.csv
			P_AC_FFID_SRC_COORD_SRC_DEPTH_3a.csv
			P_AC_FFID_SRC_COORD_SRC_DEPTH_3b.csv
			P_AC_REC_ID_REC_COORD_MC_COMPONENT_1a.csv
			P_AC_REC_ID_REC_COORD_MC_COMPONENT_1b.csv
			P_AC_REC_ID_REC_COORD_MC_COMPONENT_2a.csv
			P_AC_REC_ID_REC_COORD_MC_COMPONENT_2b.csv
			P_AC_REC_ID_REC_COORD_MC_COMPONENT_3a.csv
			P_AC_REC_ID_REC_COORD_MC_COMPONENT_3b.csv
		P_AC_X_2_c_Geometry_separation_LINE_AC.segy	
		P_AC_X_2_c_Geometry_separation_STRING.segy	
	PlaneBA	***geometry***	P_BA_FFID_SRC_COORD_SRC_DEPTH_1a.csv
			P_BA_FID_SRC_COORD_SRC_DEPTH_1aa.csv
			P_BA_FFID_SRC_COORD_SRC_DEPTH_1b.csv
			P_BA_FID_SRC_COORD_SRC_DEPTH_1bb.csv
			P_BA_FFID_SRC_COORD_SRC_DEPTH_2a.csv
			P_BA_FID_SRC_COORD_SRC_DEPTH_2aa.csv
			P_BA_FFID_SRC_COORD_SRC_DEPTH_2b.csv
			P_BA_FID_SRC_COORD_SRC_DEPTH_2bb.csv
			P_BA_FFID_SRC_COORD_SRC_DEPTH_3a.csv
			P_BA_FFID_SRC_COORD_SRC_DEPTH_3b.csv
			P_BA_README.txt
			P_BA_REC_ID_REC_COORD_MC_COMPONENT_1a.csv
			P_BA_REC_ID_REC_COORD_MC_COMPONENT_1b.csv
			P_BA_REC_ID_REC_COORD_MC_COMPONENT_2a.csv
			P_BA_REC_ID_REC_COORD_MC_COMPONENT_2b.csv
			P_BA_REC_ID_REC_COORD_MC_COMPONENT_3a.csv
			P_BA_REC_ID_REC_COORD_MC_COMPONENT_3b.csv
		P_BA_X_2_c_Geometry_separation_CIRCLE.segy	
		P_BA_X_2_c_Geometry_separation_LINE_BA.segy	
		P_BA_X_2_c_Geometry_separation_LINE_BC.segy	
		P_BA_X_2_c_Geometry_separation_STRING.segy	
	PlaneBC	***geometry***	P_BC_FFID_SRC_COORD_SRC_DEPTH_1a.csv

			P_BC_FFID_SRC_COORD_SRC_DEPTH_1b.csv
			P_BC_FFID_SRC_COORD_SRC_DEPTH_2a.csv
			P_BC_FFID_SRC_COORD_SRC_DEPTH_2b.csv
			P_BC_FFID_SRC_COORD_SRC_DEPTH_3a.csv
			P_BC_FFID_SRC_COORD_SRC_DEPTH_3b.csv
			P_BC_REC_ID_REC_COORD_MC_COMPONENT_1a.csv
			P_BC_REC_ID_REC_COORD_MC_COMPONENT_1b.csv
			P_BC_REC_ID_REC_COORD_MC_COMPONENT_2a.csv
			P_BC_REC_ID_REC_COORD_MC_COMPONENT_2b.csv
			P_BC_REC_ID_REC_COORD_MC_COMPONENT_3a.csv
			P_BC_REC_ID_REC_COORD_MC_COMPONENT_3b.csv
		P_BC_X_2_c_Geometry_separation_CIRCLE.segy	
		P_BC_X_2_c_Geometry_separation_LINE_BA.segy	
		P_BC_X_2_c_Geometry_separation_LINE_BC.segy	
		P_BC_X_2_c_Geometry_separation_STRING.segy	

4.1.2. Folder 5068-002_Beraus-et-al_SH

Folder	***Subfolder***/file	file
SH	***geometry***	SH_FFID_SRC_COORD_SRC_DEPTH_SRC_ORI_1a.csv
		SH_FFID_SRC_COORD_SRC_DEPTH_SRC_ORI_1b.csv
		SH_FFID_SRC_COORD_SRC_DEPTH_SRC_ORI_2a.csv
		SH_FFID_SRC_COORD_SRC_DEPTH_SRC_ORI_2b.csv
		SH_REC_ID_REC_COORD_MC_COMPONENT_1a.csv
		SH_REC_ID_REC_COORD_MC_COMPONENT_1b.csv
		SH_REC_ID_REC_COORD_MC_COMPONENT_2a.csv
		SH_REC_ID_REC_COORD_MC_COMPONENT_2b.csv
	SH_X_2_c_Geometry_separation_CIRCLE.segy	
	SH_X_2_c_Geometry_separation_LINE_BA.segy	
	SH_X_2_c_Geometry_separation_LINE_BC.segy	
	SH_X_2_c_Geometry_separation_STRING.segy	

4.1.3. Folder 5068-002_Beraus-et-al_SV

Folder	***Subfolder/***file	file
SV	***geometry***	SV_FFID_SRC_COORD_SRC_DEPTH_SRC_ORI_1a.csv
		SV_FFID_SRC_COORD_SRC_DEPTH_SRC_ORI_1b.csv
		SV_FFID_SRC_COORD_SRC_DEPTH_SRC_ORI_2a.csv
		SV_FFID_SRC_COORD_SRC_DEPTH_SRC_ORI_2b.csv
		SV_REC_ID_REC_COORD_MC_COMPONENT_1a.csv
		SV_REC_ID_REC_COORD_MC_COMPONENT_1b.csv
		SV_REC_ID_REC_COORD_MC_COMPONENT_2a.csv
		SV_REC_ID_REC_COORD_MC_COMPONENT_2b.csv
	SV_X_2_c_Geometry_separation_CIRCLE.segy	
	SV_X_2_c_Geometry_separation_LINE_BA.segy	
	SV_X_2_c_Geometry_separation_LINE_BC.segy	
	SV_X_2_c_Geometry_separation_STRING.segy	

4.2. File naming convention

P: seismic data acquired with sparker source between boreholes 5068_1_B and 5068_1_A (PlaneBA), 5068_1_B and 5068_1_C (PlaneBC), and 5068_1_A and 5068_1_C (PlaneAC)

SH: seismic data acquired with horizontally polarizing shear wave source between boreholes 5068_1_B and 5068_1_C

SV: seismic data acquired with vertically polarizing shear wave source between borehole 5068_1_B and 5068_1_C

CIRCLE: seismic data acquired on a circle with a radius of about 28 m around borehole 5068_1_B with three-component surface geophones; inline component points towards borehole 5068_1_B

STRING: crosshole seismic data

LINE_BA: seismic data acquired on a line connecting borehole 5068_1_B and 5068_1_A with three-component surface geophones

LINE_BC: seismic data acquired on a line connecting borehole 5068_1_B and 5068_1_C with three-component surface geophones

LINE_AC: seismic data acquired on a line connecting borehole 5068_1_A and 5068_1_C with three-component surface geophones

FFID_SRC_COORD_SRC_DEPTH_<digit><letter>.csv: geometry files connecting **FFID** (field file identification number) and source coordinates and source depth. The digit-letter-combination refers to the receiver string layout as given in Table 1.

FFID_SRC_COORD_SRC_DEPTH_SRC_ORI_<digit><letter>.csv: geometry files connecting **FFID** (field file identification number) and source coordinates, source depth, and source orientation. The digit-letter-combination refers to the receiver string layout as given in Table 1.

REC_ID_REC_COORD_MC_COMPONENT_<digit><letter>.csv: geometry file connecting the channnel in acquisition with the receiver coordinates and the component as well as assigning a receiver ID. The digit-letter-combination refers to the receiver string layout as given in Table 1.

Table 1. P-wave acquisition coverage of plane AB, plane BC, and plane AC. The source and receiver spacing within the layouts is 2 m. Layouts with double letter, e.g., "aa", are referred to as the staggered scheme. The effective receiver spacing is 1 m. Note that for layout 3b of plane AC, the planned receiver positions (in brackets) differ from the actual positions because the string was not moved downwards. Modified after Beraus et al. (2024).

Layout	plane BA		plane BC			Plane AC	
	receiver depth [m]	source depth [m]	receiver depth [m]	source depth [m]	source spacing [m]	receiver depth [m]	source depth [m]
1a	40-86	36-64	28-74	37-125	2	36-82	42-121
1aa	40-86	37-91					
1b	41-87	37-65	29-75	37-125	2	37-83	42-122
1bb	41-87	38-92					
2a	63-109	38-136	76-122	60-146	1	71-117	42-156
2aa	63-109	63-109					
2b	64-110	37-137	77-123	61-146	1	72-118	42-156

Layout	plane BA		plane BC			Plane AC	
	receiver depth [m]	source depth [m]	receiver depth [m]	source depth [m]	source spac-ing [m]	receiver depth [m]	source depth [m]
2bb	64-110	64-106					
3a	109-155	66-147	115-161	66-147	1	118-164 (117-163)	74-156
3b	110-156	67-147	116-162	67-147	1	118-164	74-156

Table 2. S-wave acquisition coverage of plane BC. The receiver spacing within the layouts is 2 m. The source spacing is 1 m. Modified after Beraus et al. (2024)

Layout	Receiver depth [m]	SV-source depth [m]	SH-source depth [m]
1a	105-119	77-136	77-147
1b	106-120	77-136	77-147
2a	119-133	91-143	91-147
2b	120-134	92-143	91-147

5. References

Beraus, S., Burschil, T., Buness, H., Köhn, D., Bohlen, T., Gabriel, G.: Comprehensive crosshole seismic experiment in glacial sediments of the Tannwald Basin (ICDP DOVE), Scientific Drilling, ?, ???, ?????, 2024.

DOVE-Phase 1 Scientific Team, Anselmetti, F. S., Beraus, S., Buechi, M. W., Buness, H., Burschil, T., Fiebig, M., Firla, G., Gabriel, G., Gegg, L., Grelle, T., Heeschen, K., Kroemer, E., Lehne, C., Lüthgens, C., Neuhuber, S., Preusser, F., Schaller, S., Schmalfuss, C., … Wonik, T. (2023). Drilling Overdeepened Alpine Valleys (DOVE) – Operational Report of Phase 1. GFZ German Research Centre for Geosciences. https://doi.org/10.48440/ICDP.5068.001

Schaller, Sebastian; Buechi, Marius W.; Schuster, Bennet; Anselmetti, Flavio S. (2023): Drilling into a deep buried valley (ICDP DOVE): a 252 m long sediment succession from a glacial overdeepening in northwestern Switzerland. Scientific Drilling. 10.5194/sd-32-27-2023

Schuster, Bennet; Gegg, Lukas; Schaller, Sebastian; Buechi, Marius W.; Tanner, David C.; Wielandt-Schuster, Ulrike; et al. (2024): Shaped and filled by the Rhine Glacier: the overdeepened Tannwald Basin in southwestern Germany. Scientific Drilling. 10.5194/sd-33-191-2024