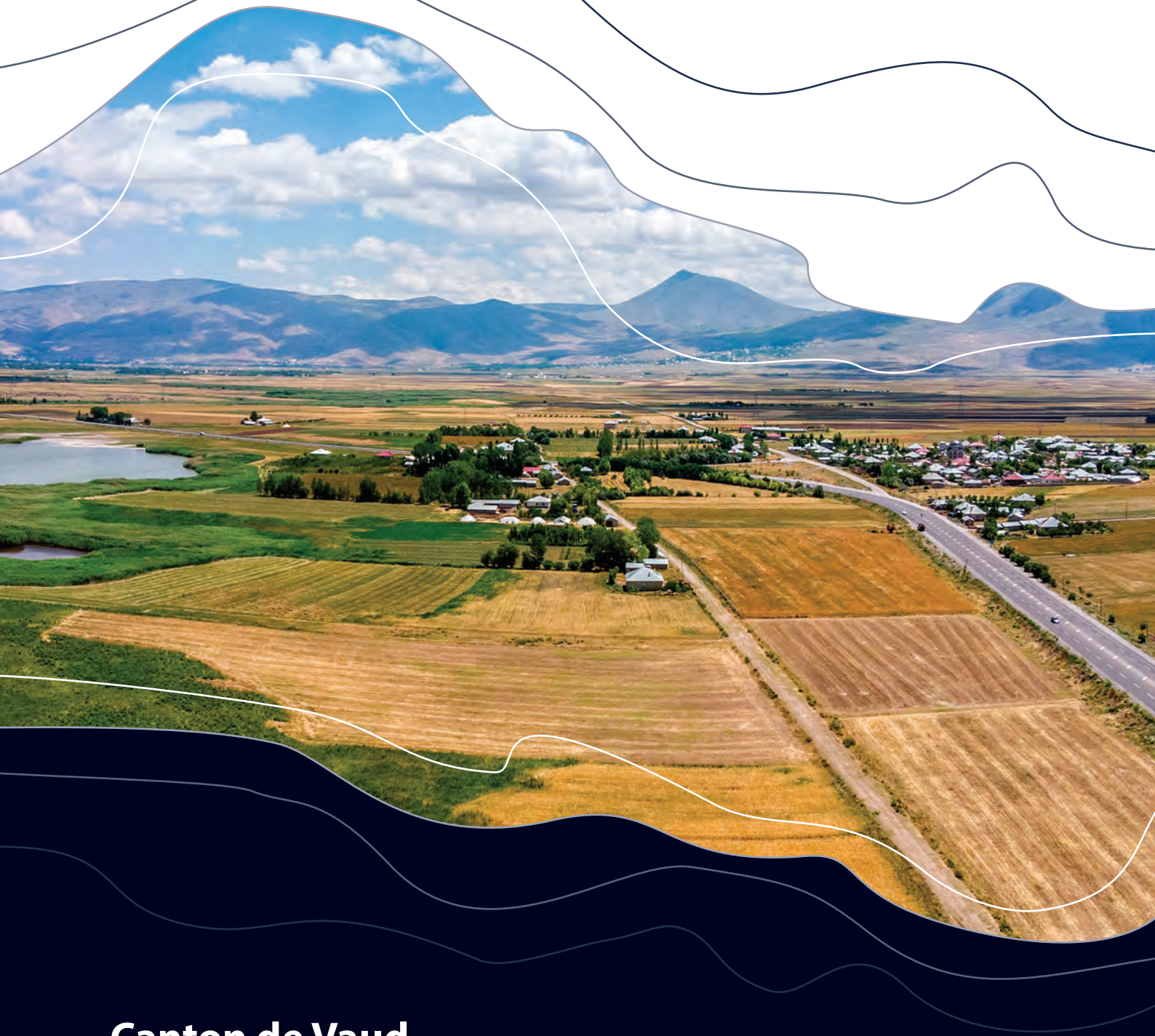
realtimeseismic



Canton de Vaud
Geometry Reconstruction

Data Processing Report

05.11.2024

France

realtimeseismic

Realtimeseismic
RCS 819 459 355
Technopole Hélioparc 2, Avenue du
Président Pierre ANGOT 64000 – PAU FRANCE

+33 (0)9 7256 0374
info@realtimeseismic.com
realtimeseismic.com

realtimeseismic

Table of Contents

realtimeseismic

List of Figures

realtimeseismic

List of Tables

1 INTRODUCTION

Study Description
Realtimeseismic (RTS) was mandated by the Canton de Vaud to complete the reconstruction of 230 seismic lines geometry, spanning a cumulative length of approximately 2152 Km, located around the city of Lausanne, Switzerland (Fig. 4.1).

The objective of this project is to reconstruct the geometry of the seismic lines, which will be processed later to assess the geothermal potential around Lausanne.

After a thorough and meticulous analyse of the data, it was concluded that 193 lines were deemed appropriate and feasible for reconstruction. Subsequently, it was determined that 37 lines could not be subjected to the reconstruction process due to the unavailability of seismic data. This information is essential for the accurate and reliable reconstruction of the complex acquisition geometry associated with these lines. However, 77 of the reconstructed lines were completed without the presence of certain essential acquisition documents, such as elevation, navigation, and observer logs.

2D Reconstruction Objectives
The main objective of this geometry reconstruction is to assign each seismic trace its corresponding coordinates while minimising uncertainties as much as possible. Each reconstructed line must be accompanied by a NavMerge file in SEGY format.

Challenges
The main challenges encountered during this project are related to:

- The absence of seismic data
- The absence of field logs (obslogs)
- The absence of receiver and source coordinates

Deliverables
The mandate given to RTS includes the delivery of :

- NavMerge files
- Geometry quality control (QC) files
- A diagnostic summary file of the lines
- Line locations in shapefile format

In addition, RTS provided 10 PSTMs (image format only) to provide an additional QC of the reconstruction quality.

2 SCOPE OF WORK

2.1 Objectives

The company Realtimeseismic (RTS) was mandated by the Canton de Vaud to reconstruct 230 2D seismic lines, covering a total length of 2152 km, located in Switzerland around the city of Lausanne. The objective of this project is to reconstruct the geometry of the seismic lines, which will be processed later to assess the geothermal potential in this area.

The main objective of this geometry reconstruction project is to deliver NavMerge file in SEGY format while minimising uncertainties as much as possible.

2.2 Resources and Project Timing

The key individuals identified as points of contact during the Kick-Off Meeting (KOM) were Loic BAZALGETTE representing Canton de Vaud, and Claudio STROBBIA representing RTS. In addition to these individuals, the project team from RTS included Zacarias SOUSA as the main processor and Juba HACHOUR as processor.

Table 2.1. Project Team

CANTON DE VAUD (CV)	**Realtimeseismic (RTS)**
Loic BAZALGETTE	Claudio STROBBIA
Robin MARCHANT	Zacarias SOUSA
	Juba HACHOUR
	Yannick BOUET

This reprocessing project started on 16thof May 2024 after a Kick-off meeting and ended on the 18th of October 2024 with the sending of approved deliverables.

2.3 Data to be reconstructed

The lines to be reconstructed and their respective lengths are listed in Table 2.2.

Table 2.2. Lines Summary

Line Name	**Length (km)**
72N5	5.340
72N6	7.980
ECL-12-01	6.520
ECL-12-02	5.320
ECL-12-03	6.220
M1-Marchairuz1972	7.740
M2-Marchairuz1972	6.480
N93-WF-10	8.000
N93-WS-20	8.000
PSBR8001	7.950
PSBR8002	17.250
PSBR8103	17.450
PSBR8104	23.150
PSBR8105	8.400
PSBR8106	8.350
PSBR8107	11.450
PSBR8308	13.920

PSBR8309	16.020
PSBR8310	4.470
PSBR8311	3.900
PSBR8312	5.190
PSBR8313	5.520
PSBR8314	5.430
PSBR8315	26.760
PSBR8316	3.870
PSBR8317	9.630
PSBR8318	9.240
PSBR8319	17.880
PSBR8320	8.490
PSBR8321	3.600
PSBR8422	6.780
PSBR8423	5.220
PSBR8424	15.330
PSBR8425	4.230
PSBR8426	4.470
PSBR8427	17.760
PSBR8428	9.960
PSBR8429	11.760
PSBR8430	4.960
PSBR8502	17.430
PSBR8801	10.875
PSBR8802	9.150
PSBR8803	11.625
PSBR8804	6.675
PSBR8805	10.050
PSBR8806	5.875
PSBR9001	2.900
PSBR900101	3.900
PSBR900102	>6.400
PSBR900103	>5.980
PSBR900201	>3.780
PSBR900202	>32.300
PSBR900301	>12.240
PSBR900302	>29.840
PSBR9004	1.650
PSBR900401	>10.480
PSBR900402	2.650
PSBR900403	>19.040
PSBR900503	4.740
PSBR9005	4.500
PSBR900501	6.260
PSBR900502	5.080
PSBR9006	3.980
PSBR900601	>5.680
PSBR900602	>5.680
PSBR900603	>2.700
PSBR9007	0.850
PSBR900701	2.110
PSBR900702	>8.020
PSBR900703	>7.500
PSBR900801	>10.300

PSBR900802	7.750
PSBR900803	10.150
PSBR9009	10.150
PSBR900901	7.200
PSBR9011	>3.540
SADH730001	12.975
SADH730002	8.925
SADH730003	5.580
SADH730004	17.475
SADH730005	14.775
SADH740008	9.840
SADH740009	15.840
SADH740010	10.875
SADH740011	13.560
SADH740012	14.625
SADH740013	16.800
SADH740014	24.075
SADH760015	36.330
SADH760016	27.580
SADH760017	25.830
SADH760018	24.500
SADH770001	30.300
SADH770011	8.300
SADH770012	7.650
SADH770013	6.950
SADH770014	7.850
SADH770015	6.350
SADH770016	6.500
SADH770017	5.200
SADH770018	6.400
SADH780019	15.200
SADH780020	10.850
SADH780021	38.280
SADH780022	16.680
SADH780023	17.160
SADH790024	40.140
SADH790025	12.400
SADH790026	14.950
SADH790027	41.940
SADH8401	45.090
SADH8402	17.730
SADH8403	22.020
SADH8601	24.444
SADH8602	14.076
SADH8603	24.120
SADH8604	21.480
SADH8605	10.692
SADH8606	10.770
SADH8607	25.950
SADH8608	9.720
V3-LaValle1972	8.640
V4-LaValle1972	5.040
VD2012_01	14.610
VD2012_02	15.840

VD2012_03	14.730
VD2012_04	15.600
VD2012_05	15.690
VD2012_06	10.770
VD2012_07	11.250
VD2012_08	11.310
VD2012_09	13.560
VD2012_10	10.740
VD2012_11	12.570
VD2012_12	9.210
VD-P730002	9.300
VD-P730003	5.002
VD-P730004	4.680
VD-P730008	5.640
VD-P730009	4.680
VD-P730010	13.020
VD-P730011	3.780
VD-P730012	14.325
VD-P730013	13.575
VD-P730014	8.025
VD-P730015	6.825
VD-P730016	6.375
VD-P730017	6.375
VD-P730018	3.600
VD-P730019	5.250
VD-P730020	5.475
VD-P730021	6.825
VD-P730022	5.925
VD-P730023	27.750
VD-P730024	4.440
VD-P730025	7.140
VD-P730026	4.800
VD-P730027	8.175
VD-P730028	3.240
VD-P740032	19.560
VD-P740033	9.180
VD-P740040	6.600
VD-P740041	9.300
VD-P740042	4.440
VD-P740043	4.440
VD-P740044	6.120
VD-P740045	6.600
VD-P740046	8.050
VD-P740047	7.300
VD-P740048	4.050
VD-P740049	9.420
VD-P740050	5.220
VD-P740051	7.020
VD-P740053	9.240
VD-P740054	12.780
VD-P750055	11.700
VD-P760059	6.230
VD-P760060	6.720
VD-P760063	11.700

VD-P760064	25.350
VD-P760067	16.315
VD-P760070	9.900
VD-P760071	9.540
VD-P760072	8.520
VD-P770002	16.450
VD-P770003	7.110
VD-P770004	8.925
VD-P770006	8.007
16-SIL-01	12.550
16-SIL-02	9.400
16-SIL-03	11.675
16-SIL-04	10.600
TOTAL	2151.591

3 METHODOLOGY AND INTERMEDIATE RESULTS

The following sections describe the geometry reconstruction sequences aimed at achieving a Navmerge without geometry errors.

3.1 General workflow

The following workflow outlines the main stages of the geometry reconstruction:

- **Step 1:** Input Data Diagnostic
- **Step 2:** Line Reconstruction
- **Step 3:** Quality Control

Input Data Diagnostic:
The steps are described in Table 3.1

Table 3.1. Diagnostic of input data

Inpu data	Jobs	Outputs
Seismic data, Observer log file, Navigation file and CMP coordinates file	Quality Control of Received Data	Diagnostic summary table (XLSX)

Fig. 3.1 corresponds to the summary of the Table 3.1 .

Fig. 3.1. Data diagnostic

Geometry Reconstruction Steps:
The steps are described in Table 3.2

Table 3.2. Geometry Reconstruction Steps

Inputs Data	Digitization	Line Geometry Reconstruction	Outputs
• Seismic data • Observer log file • Navigation file	• Observer log file (XLSX) • Coordinates file (XLSX) • Elevation file (XLSX)	• QC of Sources/ Receivers coordinates • Elevation QC • Merge Navigation file with seismic file • QC of Navmerge	• Navmerge (SGY) • Report of Geometry QC (PPTX)

Fig. 3.2 corresponds to the summary of the Table 3.2.

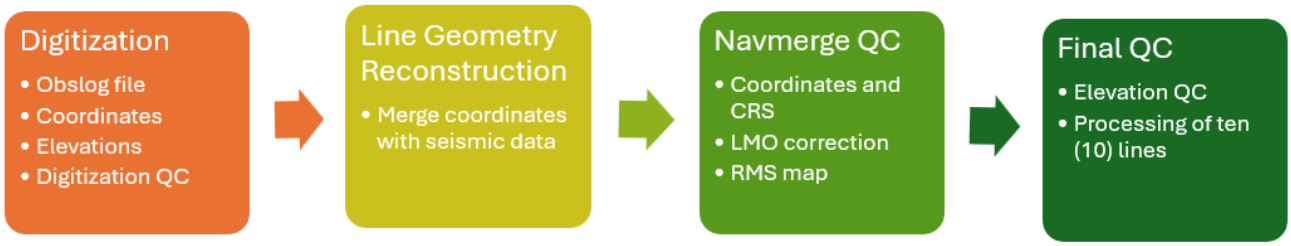


Fig. 3.2. Geometry reconstruction and QC steps

3.2 Step 1: Input Data Diagnostic

Input data requirements

The geometry reconstruction step is intended to import the geometry into the raw seismic file. Raw seismic data is recorded in specific binary data formats defined by the Society of Exploration Geophysicists (SEG). This format includes, among other things, digitised seismic reflection amplitude samples, the shot number (FFID), the sampling interval, the number of samples per trace, the number of channels, and other information organised in blocks called headers (Fig. 3.3).

ind_tr	ds_seqno	ffid	chan	source	cmp	trc_type	offset	rec_elev	sou_elev	depth	elev_datum_rec	elev_datum_sou	scal_elev	scal_loc	sou_x	sou_y	rec_x	rec_y	delay	sample	si	cmp_x	cmp_y	ffid_ind
1	94	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5888	2000	0	0	0
2	95	1	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5888	2000	0	0	0
3	96	1	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5888	2000	0	0	0
4	97	1	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5888	2000	0	0	0
5	98	1	5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5888	2000	0	0	0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2780	2407	369	20	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5888	2000	0	0	0
2781	2408	369	21	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5888	2000	0	0	0
2782	2409	369	22	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5888	2000	0	0	0
2783	2410	369	23	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5888	2000	0	0	0
2784	2411	369	24	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5888	2000	0	0	0

2784 rows × 27 columns

Fig. 3.3. Example of raw seismic headers

The import of the geometry of a seismic line is done using the information on the layout of the spread and the actual coordinates of each shot point (SP) and geophone (RP). All geometry-related information can be found in what is called an observer log file (Fig. 3.4), and navigation information is often in a separate file called a navigation file.

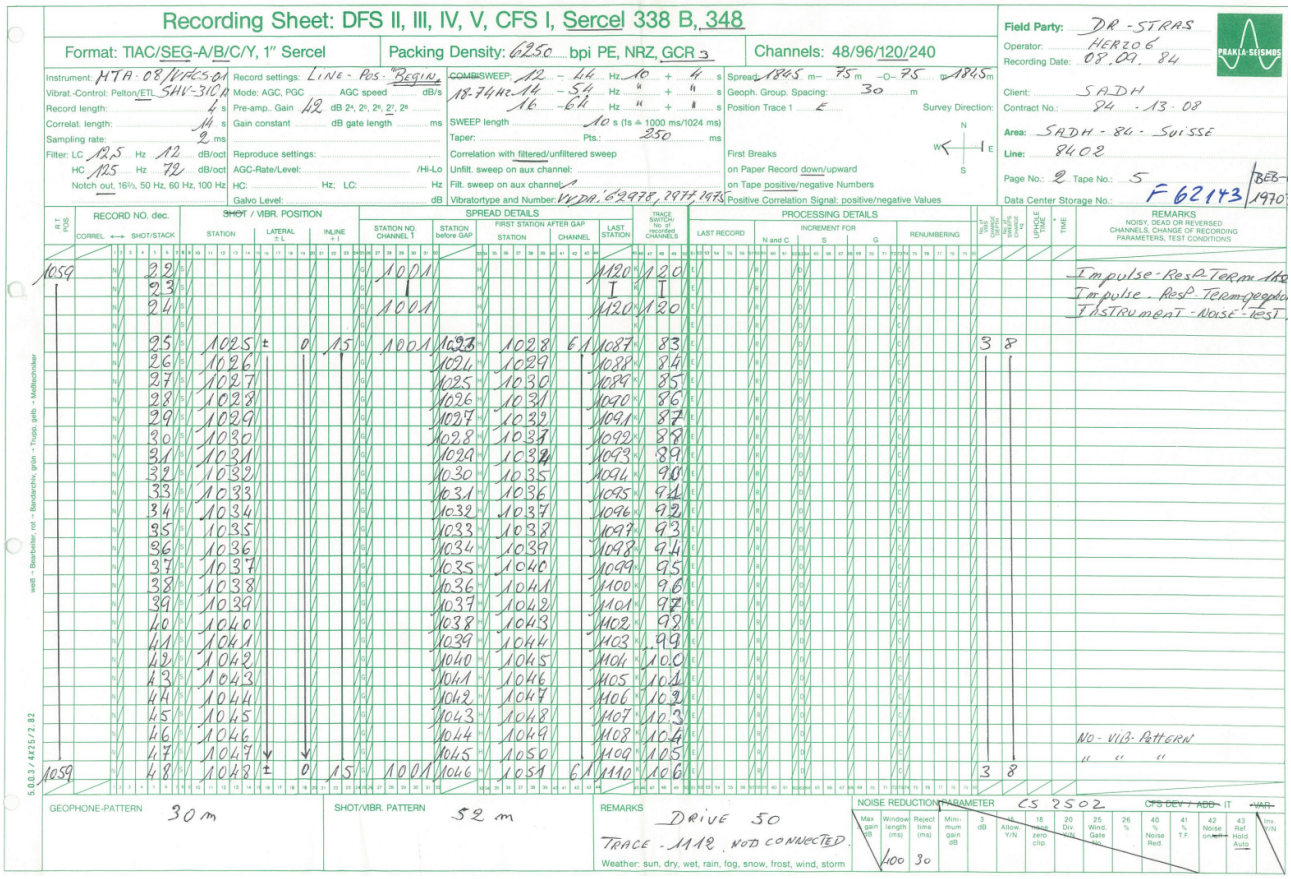


Fig. 3.4. Example of Observer log field

For older data, such as the majority of lines in this project, after the digitization of field documents and their entry into a database, a correspondence with the traces of the raw seismic data is established.

Once this correspondence is made, this information is loaded into the headers of the seismic data traces (Fig. 3.5). This merging is necessary because it allows for sorting the traces into different domains or groups (according to various geometric criteria: Common Shot Gather or CSG, Common Receiver Gather or CRG, Common Offset Gather or COG, or Common Depth Gather or CDG, etc.), which is essential for the processing steps.

ind_tr	ds_seqno	ffid	chan	source	cmp	trc_type	offset	rec_elev	sou_elev	depth	elev_datum_rec	elev_datum_sou	scal_elev	scal_loc	sou_x	sou_y	rec_x	rec_y	delay	sample
1	94	1	1	0	0	1.0	0	479.0	472.0	0	0	0	0	0	2505351.903	1139134.964	2.505138e+06	1.139440e+06	0	5888
2	95	1	2	0	0	1.0	0	479.0	472.0	0	0	0	0	0	2505351.903	1139134.964	2.505107e+06	1.139492e+06	0	5888
3	96	1	3	0	0	1.0	0	482.0	472.0	0	0	0	0	0	2505351.903	1139134.964	2.505077e+06	1.139545e+06	0	5888
4	97	1	4	0	0	1.0	0	482.0	472.0	0	0	0	0	0	2505351.903	1139134.964	2.505052e+06	1.139600e+06	0	5888
5	98	1	5	0	0	1.0	0	483.0	472.0	0	0	0	0	0	2505351.903	1139134.964	2.505029e+06	1.139657e+06	0	5888
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2644	2407	369	20	0	0	1.0	0	640.0	682.0	0	0	0	0	0	2503076.890	1142905.497	2.503274e+06	1.142427e+06	0	5888
2645	2408	369	21	0	0	1.0	0	644.0	682.0	0	0	0	0	0	2503076.890	1142905.497	2.503307e+06	1.142500e+06	0	5888
2646	2409	369	22	0	0	1.0	0	656.0	682.0	0	0	0	0	0	2503076.890	1142905.497	2.503273e+06	1.142553e+06	0	5888
2647	2410	369	23	0	0	1.0	0	663.0	682.0	0	0	0	0	0	2503076.890	1142905.497	2.503226e+06	1.142602e+06	0	5888
2648	2411	369	24	0	0	1.0	0	666.0	682.0	0	0	0	0	0	2503076.890	1142905.497	2.503173e+06	1.142650e+06	0	5888

2648 rows × 30 columns

Fig. 3.5. Example of headers of Navmerge

Mandatory input data:

- **Seismic Data (SEG-Y format)**:

Seismic data are essential for the reconstruction of a seismic line. These are raw recordings that must be cleaned (removal of empty shots, dead traces, auxiliary traces, noisy traces, etc.) before being merged with the actual coordinates of each shot point (SP) and each geophone (RP).

Critical input data:

- **Field Observer Logs**:
  These are field reports that establish the relationship between acquired data and the work performed on-site. They contain critical information such as the spread configuration, shot numbers, receiver numbers, and the correspondence between seismic files (FFID) and shot point numbers.
- **Source and Receiver Coordinates (X, Y)**:
  The X and Y coordinates are necessary to accurately position each source and receiver on the field, ensuring the geometric integrity of the seismic data.
- **Source and Receiver Elevations (Z)**:
  Elevation data (Z) for sources and receivers are crucial to account for the terrain's topography, thereby enhancing the accuracy of the geometric reconstruction.

Input data diagnostic
Therefore, the first step was to review what information was received and to produce an **inventory list.**

From this inventory, anomalies were identified (e.g. missing file or incorrect information) and categorised. For each category, a set of possible correction solutions were applied in the second step of the workflow.

3.3 Step 2: geometry reconstruction

3.3.1 General case

As mentioned in the 3.2 Step 1: Input Data Diagnostic section, for the geometry reconstruction of each line, it is crucial to have the following elements:

Mandatory:

- **Seismic Data**

Critical:

- **Field Observer Logs**
- **Source and Receiver Coordinates**
- **Source and Receiver Elevations**

If all the information above is available, then the NaveMerge file can be produced using GeoThrust (TM) software.

The NaveMerge file must then be verified (QC), which is the Step 3 of the workflow (see 3.4 Step 3: quality control).

3.3.2 Lines without observer logs

As mentioned in 3.3 Step 2: geometry reconstruction section, the field observer log file (obslog) contains all the essential geometric information, such as spread layout and shot numbers (FFID). However, for older seismic acquisitions, this file is often missing, making the geometric reconstruction of the lines less accurate or even impossible in some cases. This is the situation for the Canton de Vaud project, where 32 lines are affected (**Table 3.3**).

Table 3.3. Lines without observer logs

Lines without observer logs
N93-WF-10
N93-WS-20
PSBR8505
PSBR900102
PSBR900103
PSBR900201
PSBR900202
PSBR900301
PSBR900302
PSBR900402
PSBR900403
PSBR900404
PSBR900502
PSBR900601
PSBR900602
PSBR900603
PSBR900702
PSBR900703
PSBR900801
PSBR900802
PSBR900803
PSBR900901
PSBR900902
PSBR9011
SADH760017
SADH760018
SADH770001
VD-P730023
VD-P740046
VD-P770002
VD-P770003
VD-P770004

Despite this, it is possible to attempt the reconstruction of these lines by adopting different strategies:

Proposed Solutions:

1. **Searching for information in the seismic files**:
   Analyze the content of the raw data to retrieve missing geometric information.
2. **Creating a theoretical observer log**:
   Reconstruct geometric relationships using theoretical models based on assumptions, relying on the general spread layout.

Potential Issues:

The repetition of shots may complicate the creation of a coherent relationship file, requiring multiple hypotheses to be tested before reaching a satisfactory result.

Consequences on seismic processing:

Even if the quality control (QC) indicates an acceptable result, issues may arise during data processing, such as:

- Misalignments in the gathers (CSG or CRG).

- Incorrect tomographic models.
- Ineffective primary statics.
- Cycle skips.
- Inconsistent amplitudes within trace groups.
- Spatial misplacement of receivers or sources, leading to artifacts during migrations.

3.3.3 Lines without coordinates

As mentioned in 3.2 Step 1: Input Data Diagnostic section, the actual positions of the sources and receivers are essential to ensure the precise geometric integrity of an acquired seismic line. For the geometry reconstruction of the lines in the Canton de Vaud project, 33% of the lines (**Table 3.4**) did not have source and receiver coordinates. However, CMP positions were available, although they were highly smoothed with regular distance intervals.

Table 3.4. Lines without coordinates (Sources or Receivers)

Lines without coordinates
72N5
72N6
M1-Marchairuz1972
M2-Marchairuz1972
N93-WF-10
N93-WS-20
PSBR8422
PSBR8423
PSBR8424
PSBR8428
PSBR8505
PSBR900102
PSBR900103
PSBR900201
PSBR900202
PSBR900301
PSBR900302
PSBR900402
PSBR900402
PSBR900403
PSBR900404
PSBR900502
PSBR900601
PSBR900602
PSBR900603
PSBR900702
PSBR900703
PSBR900801
PSBR900802
PSBR900901
PSBR900902
PSBR9011
SADH650001-08
SADH760017
SADH760018
SADH770001

SADH770002
SADH770011
SADH770012
SADH770013
SADH770014
SADH770015
SADH770016
SADH770017
SADH770018
SADH780019
SADH780020
SADH780021
SADH780022
SADH780023
SADH790024
SADH790025
SADH790026
SADH790027
V3-LaValle1972
V4-LaValle1972
VD-P730023
VD-P740046
VD-P740047
VD-P770002
VD-P770003
VD-P770004
VD-P770006
VD-P770008

Nevertheless, it is still possible to attempt reconstructing these lines by employing different strategies:

Proposed Solutions:
- Extraction of the shot or receiver coordinates using CMP coordinates (.xlsx)

Potential Issues:
- The more complex the line (e.g., with multiple bends), the lower the accuracy regarding the actual position of the sources or receivers and this requires formulating hypotheses and testing them for consistency.

Consequences on seismic processing:
- Position inaccuracies may lead to errors during subsequent data processing stages due to incorrect geometry and interpretation stages

3.3.4 Other cases

Lines without seismic data

Table 3.5. Lines without seismic data

Line name
CHABLAISU85A
CHABLAISU85B
CHABLAISU8801
CHABLAISU8802

CHABLAISU8803
CHABLAISU8804
CHABLAISU8805
CHABLAISU8806
CHABLAISU8807
FR.N8504
PSBR900405
PSBR900404
PSBR8505
PSBR900702
PSBR900703
PSBR900902
PSBR9010g
PSBR9010s
SADH770001A
VD-P730023B
VD-P770008
VD-P780073
VD-P780074
VD-P780075
VD-P780076
VD-P780077
VD-P780078
VD-P780079
VD-P780080
VD-P780081

- In the case of lines without seismic data, no solution is feasible.

Lines without any navigation data

Table 3.6. Lines without coordinates file

Line name
SADH650001-08

- In the case of lines without coordinates for sources, receivers, or CMP, no solution is also feasible.

Discrepancy between seismic data and navigation data (coordinates).

Table 3.7. Lines with seismic data vs navigation data

Line name
PSBR8501
PSBR8503
PSBR8504
PSBR8505
SADH650001-08
SADH770002
VD-P770008
VD-P780073
VD-P780074
VD-P780075
VD-P780076
VD-P780077

VD-P780078
VD-P780079
VD-P780080
VD-P780081

- In the case of seismic data that does not match the received coordinates, this is equivalent to the case of lines without seismic data or without coordinates.

3.4 Step 3: quality control

3.4.1 Geometry QC

QC methodology and steps
After the geometry construction stage, it is necessary to evaluate its consistency. A quality control (QC) phase is required not only to validate the geometry (to identify if the coordinates assigned to the different stations are correct, if there have been spread reversals, etc.) but also to detect any issues that occurred during acquisition, such as faulty recordings, missed shots, defective and/or dead channels, etc. For this, the techniques introduced previously in section **3.4 Step 3: quality control** (RMS amplitude, energy decay factors, and the effect of LMO correction) are used in combination with the station positioning data.

Each line geometry was systematically checked using a series of partly automated and partly manual steps:

- Inspection of common shot gathers
- Application of Linear Move-Out (LMO)
- Display of source and receiver station positions
- Elevation verification: source and receiver elevation, depth of sources
- Number of traces per gather: for each shot and receiver gather
- Point spacing: for each source and receiver
- RMS amplitude maps comparison: full trace
- RMS amplitude - background: background noise is estimated from the end of the trace
- Offset distribution

A dedicated presentation was produced to validate the geometry of each line. Some key outplot plots are shown below as examples.

RMS Amplitude vs Offset
The energy decay factor, as illustrated in Fig. 3.6, perfectly demonstrates the principle of energy or trace amplitude reduction with increasing distance between the source and the receivers. By examining this relationship between the seismic data, through a seismic attribute such as RMS amplitude, and the position from which the energy is emitted (shot point) to the positions where it is recorded (RP), one can determine the accuracy of the station positioning (and thus the data quality). In this case, we observe a spatial continuity of RMS amplitude, which undergoes an exponential amplitude decay

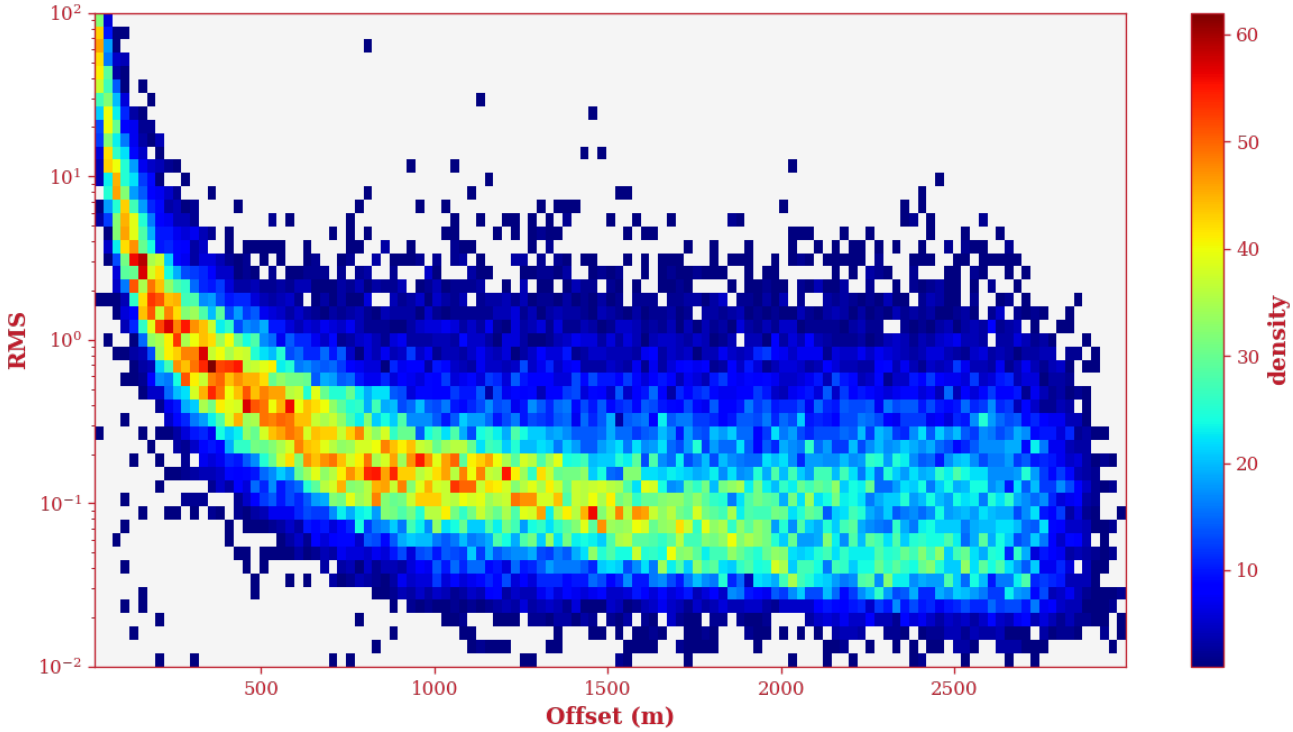


Fig. 3.6. RMS amplitude versus offset
Line 16-SIL-03

Maximum RMS Amplitude vs Minimum Offset

Fig. 3.7 illustrates a similar technique based on the theoretical principle that maximum energy values should be recorded by the receivers closest to the source. However, it is observed that this is not true for all points. Several factors, such as a noise source near a receiver, could cause very high amplitude values at larger offsets. Therefore, it is generally necessary to examine each point individually to identify consistent reasons for this behaviour.

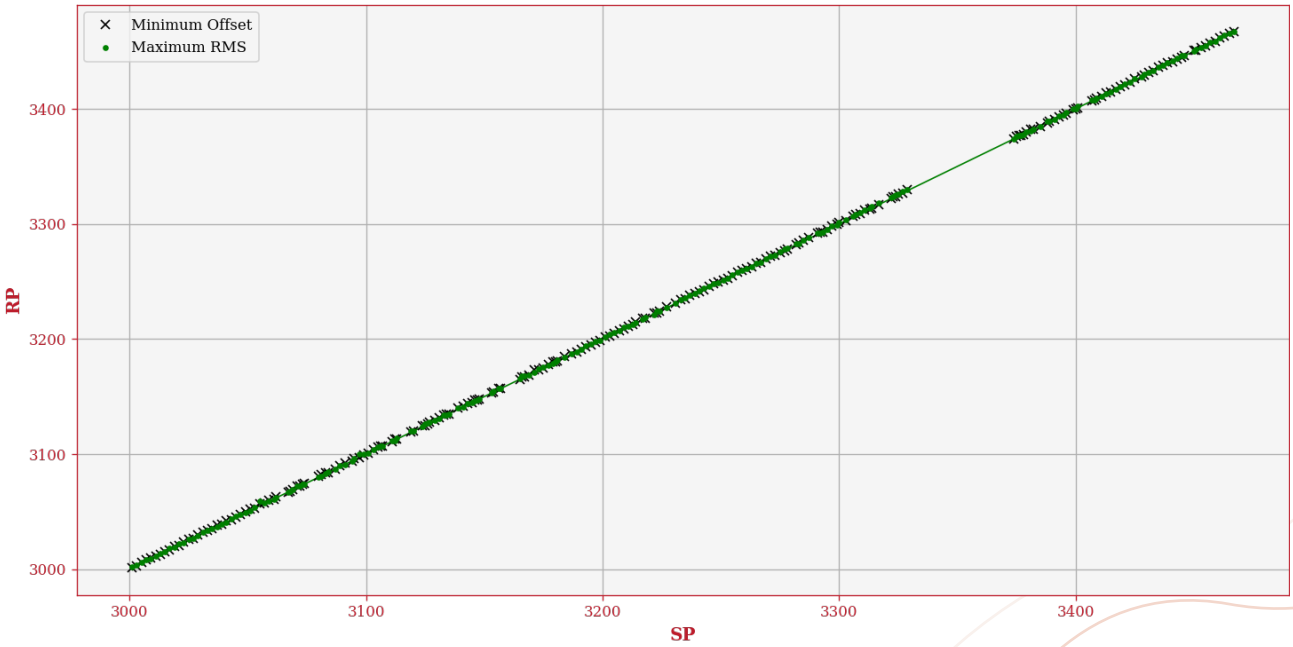


Fig. 3.7. Relationship between Minimum offset and Maximum RMS
Line 16-SIL-03

Application of Linear Move-Out (LMO)

The time of the first arrivals depends on the horizontal distance between the shot point and the receiver position. Based on this, an LMO (Linear Move-Out) correction is applied, which allows for the estimation of the first arrival velocity. If this LMO velocity matches the first arrival velocity, the arrivals will be properly flattened. Using this method, it is possible to identify and verify anomalous cases where the amplitude decay principle has not been respected. In the absence of geometry issues, the flattening of the first arrivals should occur smoothly, without interruptions or abrupt shifts. (Fig. 3.8) illustrates a CSG with LMO applied.

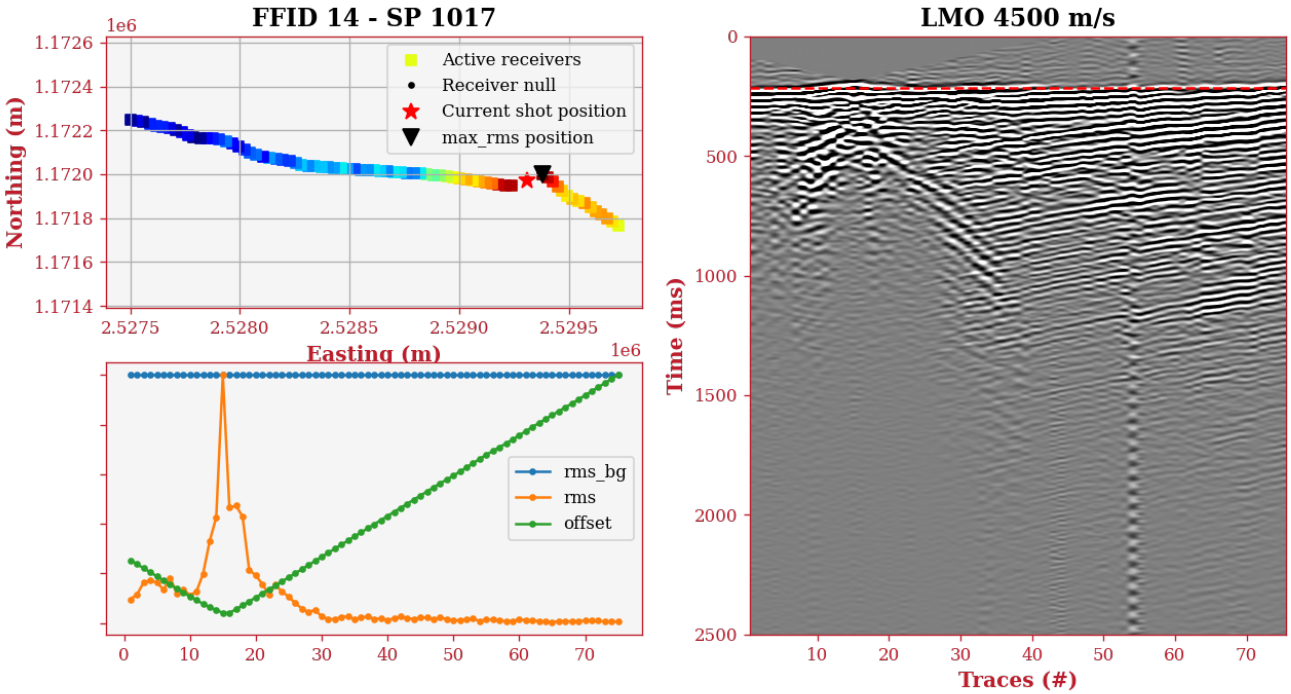


Fig. 3.8. Raw shot after application of the Linear Moveout (LMO) correction
RMS amplitude distribution on a raw shot after applying an LMO velocity of 4500 m/s (Line SADH8402).

RMS amplitude maps:

For this QC step, we calculate the RMS amplitude values and generate a map displaying these RMS values for each recorded trace. Each pixel represents a trace. Each horizontal line of pixels corresponds to all traces from a single shot point, while each vertical line of pixels represents all traces recorded by the same receiver for all shot points (Fig. 3.9).

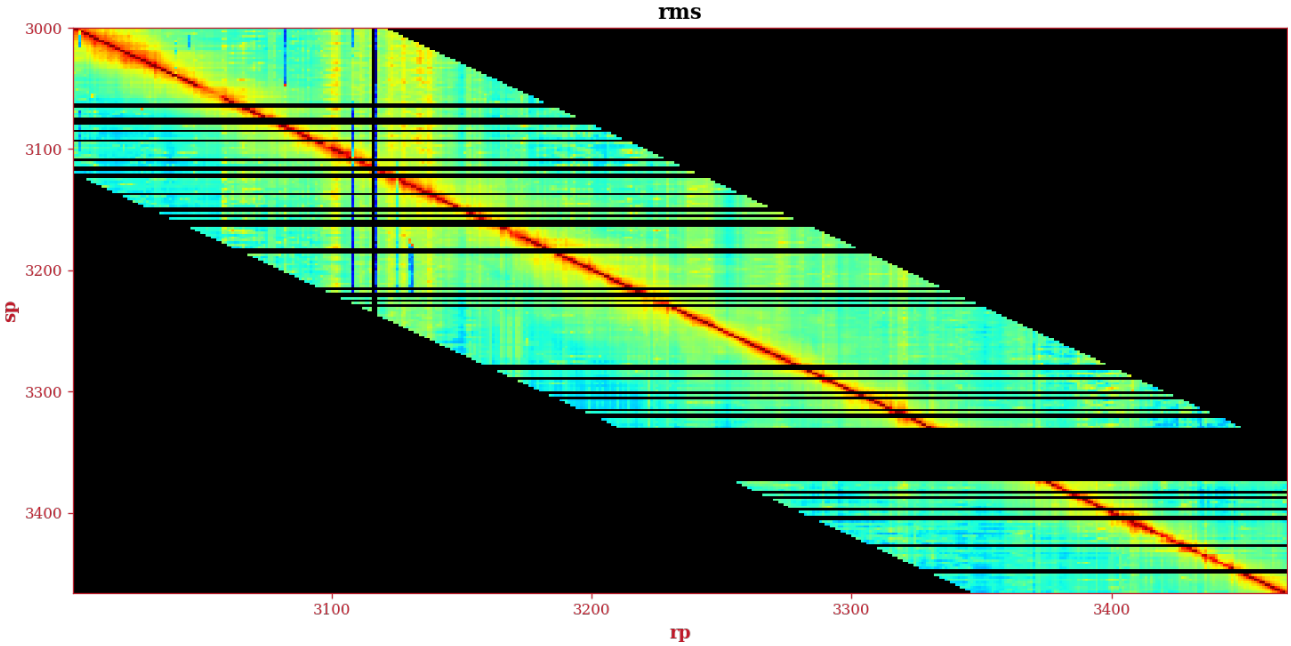


Fig. 3.9. RMS amplitude against source points (SP) and receiver points (RP)
Line 16-SIL-03

With this map, we can identify problematic receivers (dead, inconsistent amplitude values, etc.) and check for potential geometry errors based on the verticality or horizontally of anomalous behaviour in the map. For instance, if a receiver is defective and records inconsistent amplitude values, by continuity, for all shot points, each trace recorded by this receiver should show the same behaviour (unless an intervention was made in the field where it was replaced by another or the initial problem was just poor coupling with the ground, which was later fixed… normally, such information is documented in the field reports). A shift in a horizontal line for a shot point will also indicate a geometry issue.

The displays presented in this chapter were systematically produced for each of the lines in this project, helping to detect issues that were then corrected. Upon completing this phase, we successfully generated SEG-Y files (Navmerge) that incorporated a merged survey geometry.

3.4.2 Intersection QC

Elevations at intersections between lines were checked. It involves checking and validating the consistency of the elevation values assigned to the measurement points (receivers) where two seismic lines intersect. The goal is to ensure that the elevations of receivers at the intersections are consistent across the different lines, ensuring good continuity and accuracy in the seismic geometry. If discrepancies are observed, this may indicate positioning or topographic errors that could impact data quality. An example is shown below (Fig. 3.10).

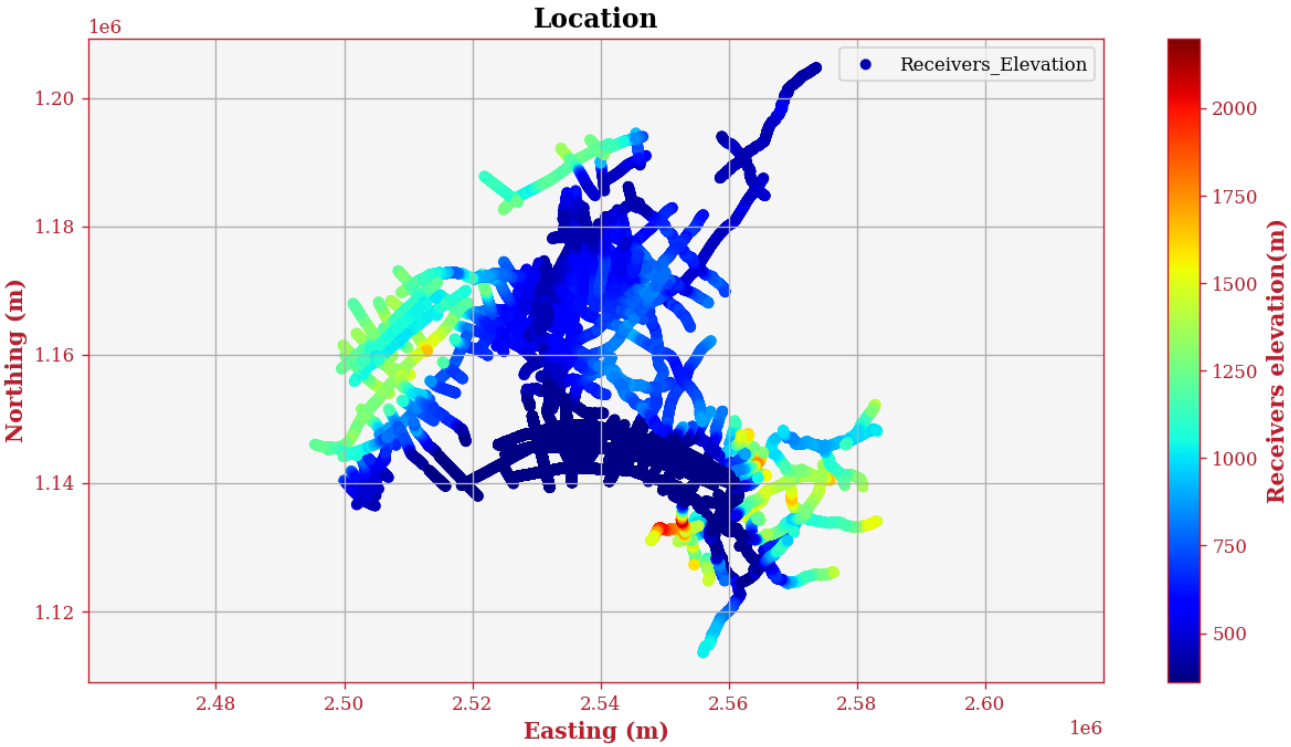


Fig. 3.10. Example of Receiver elevation QC with all lines

The processing strategy was optimized with a primary focus on the effects of geometry. The impacts related to the geometry of a line during processing are highlighted in several processing steps, such as:

1. **First Break Picking (FB):** An incorrect LMO can lead to errors in determining the first breaks.
2. **Initial Velocity Model:** A model with false velocities directly impacts processing by generating, for example, cycle skips.
3. **Incorrect Tomographic Model:** An erroneous tomographic model can produce false static corrections.
4. Inconsistent amplitudes within trace groups.
5. Spatial misplacement of receivers or sources, leading to artifacts during migrations.

Some lines were processed in order to check the quality of the geometry, because geometry errors can be seen at several of the processing steps, such as:

1. **First Break Picking (FB):** An incorrect LMO can lead to errors in determining the first breaks.
2. **Initial Velocity Model:** A model with false velocities directly impacts processing by generating, for example, cycle skips.
3. **Incorrect Tomographic Model:** An erroneous tomographic model can produce false static corrections.
4. **Inconsistent amplitudes** within trace groups.
5. **Spatial misplacement of receivers or sources**, leading to artifacts during migrations.

3.4.3.2 Project Parameters

The Table 3.8 describes the used parameters for the analysis and implementation of the processing stage.

Table 3.8. General project parameters.

ELINCS2D Reprocessing - General Project Parameters	
Lines	PSBR9001;PSBR8427;SADH8403;SADH790027; SADH790026;VD-P77002;VD-P760067;VD-P760064;VD-P750055;16-SIL-03
CRS	EPSG: 2056 - SWISS CH1903+ / LV05
Final datum	1200 m
Replacement velocity	3500 m/s
Geometry type	Crooked line
Bin size	1/2 * receiver spacing (m)
Trace length	3000/4000 ms
Sampling rate	2/4 ms

3.4.3.3 CRS, Datum, Replacement Velocity, Polarity and Phase

Coordinate Reference System
Data were processed in the Coordinate Reference System (CRS) : EPSG: 2056 - SWISS CH1903+ / LV05

Datum and Replacement Velocity
The trace is started at -1200 ms, and time-zero on the delivered PSTM stacks only relates to MSL. 3500 m/s was the used replacement velocity to go from the floating to the flat datum.

Phase and Polarity
As far as the polarity and the phase are concerned, the input data was correlated at zero phases in the field for Vibroseis data, and at minimum phase for Dynamite data. In the applied processing sequence, the phase modification, from minimum to zero, was exclusively applied to the dynamite shots on the lines that had a combination of Vibroseis and Dynamite Shots. Due to the satisfactory intersection between the lines, lines with only dynamite, the phase remained unaltered.

Polarity is the SEG positive which means an increase of impedance is a positive sample in file, centred on the positive reflection coefficient. This corresponds to the “normal polarity” (Fig. 3.11).

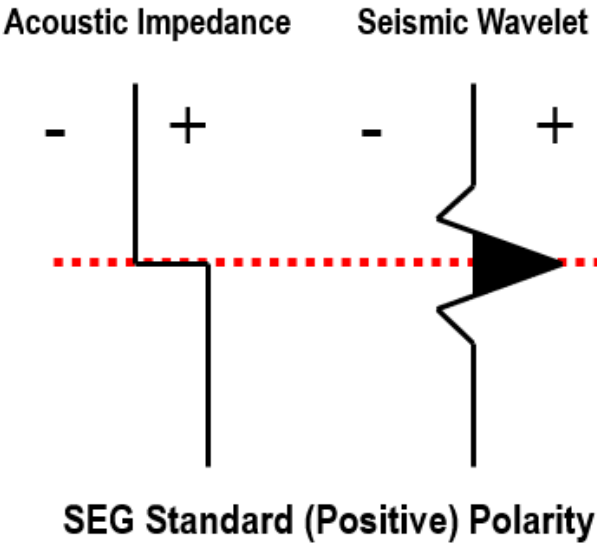


Fig. 3.11. SEG Normal (Positive) Polarity convention "An increase of acoustic impedance with depth is represented by a positive sample, displayed as a Black Peak on plot".

3.4.3.4 Processing sequence

The reprocessing includes the following steps: data verification, data preparation and preprocessing, filtering, migration, stacking, and final imaging. Each step is analyzed to optimize results and minimize artifacts. The choice of parameters is based on a thorough analysis of the data, ensuring a complete understanding of the process and the transparency of the obtained results.

The following Table 3.9 summarize the processing sequences and the parameters used to enhance the resolution and clarity of the seismic images.

Our macro-stages are included and listed below:

- Near-surface modeling
- Structural processing and imaging pre-migration
- Velocity and migration

Table 3.9. Processing workflow

STAGE		OBJECTIVE	STEPS
1	Near-surface modelling	Shallow imaging, perturbations	Surface wave analysis, diving wave tomography, sharp stochastic refraction inversion
2	Kinematic structural processing	Optimal statics, velocity, structural imaging	Structural processing, long and short wavelength statics, PSTM velocity
3	Velocity and migration	Optimal velocity and PSTM imaging	PSTM velocity, migration

Since the processing was only a quality control average, we will not go into detail about the seismic processing steps. We will present the results of our processing directly. However, we will not show all the processed lines (you will find them in the PPTX file sent to the Canton de Vaud).

Here is the list (<broken cross-reference>) of lines that were processed during the project. This processing was quick and helped us validate or reject the line geometry (thus also serving as a means of quality control).

Table 3.10. Lines to process

Name
16-SIL-03
84PSBR27
79-SADH-27
84-SADH-03
79-SADH-26
75-VD-55
PSBR-90-01
76-VD-64
76-VD-67
77-VD-02

Table 3.11. Final PSTM parameters

CANTON DE VAUD 2D Reprocessing – PSTM Parameters	
Time/Aperture pairs	0 s / 3000 m
Bin spacing	1/2 * receiver spacing (m)
Angle dip limit	35 degrees
Time increment	4 ms
Stretch mute:	45%

4 RESULTS

4.1 Result overview

Table 4.1 provides a summary of the work completed on a total of 230 seismic lines. For each line, we have listed the issues encountered and the solutions applied. Additionally, the status of each line is specified, indicating whether the geometry has been completed or if the line cannot be reconstructed. This summary aims to provide a clear and concise overview of the actions taken and their effectiveness in processing the seismic data.

Table 4.1. Summary of the work completed

Line name	Issues identified	Solution applied	Observation
72N5	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
72N6	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
CHABLAISU85A	No seismic file	No possible solution	Cannot be reconstructed
CHABLAISU85B	No seismic file	No possible solution	Cannot be reconstructed
CHABLAISU8801	No seismic file	No possible solution	Cannot be reconstructed
CHABLAISU8802	No seismic file	No possible solution	Cannot be reconstructed
CHABLAISU8803	No seismic file	No possible solution	Cannot be reconstructed
CHABLAISU8804	No seismic file	No possible solution	Cannot be reconstructed
CHABLAISU8805	No seismic file	No possible solution	Cannot be reconstructed
CHABLAISU8806	No seismic file	No possible solution	Cannot be reconstructed
CHABLAISU8807	No seismic file	No possible solution	Cannot be reconstructed
ECL-12-01	No issues to report	/	Geometry done
ECL-12-02	No issues to report	/	Geometry done
ECL-12-03	No issues to report	/	Geometry done
FR.N8504	No seismic file	No possible solution	Cannot be reconstructed
M1-Marchairuz1972	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
M2-Marchairuz1972	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
N93-WF-10	No Observer log file	Synthetic Observer log	Geometry done
N93-WS-20	No Observer log file	Synthetic Observer log	Geometry done
PSBR8001	No issues to report	/	Geometry done
PSBR8002	No issues to report	/	Geometry done
PSBR8103	No issues to report	/	Geometry done
PSBR8104	No issues to report	/	Geometry done
PSBR8105	No issues to report	/	Geometry done
PSBR8106	No issues to report	/	Geometry done
PSBR8107	No issues to report	/	Geometry done
PSB900501B	No seismic file	No possible solution	Cannot be reconstructed
PSBR8308	No issues to report	/	Geometry done
PSBR8309	No issues to report	/	Geometry done
PSBR8310	No issues to report	/	Geometry done
PSBR8311	No issues to report	/	Geometry done
PSBR8312	No issues to report	/	Geometry done
PSBR8313	No issues to report	/	Geometry done
PSBR8314	No issues to report	/	Geometry done
PSBR8315	No issues to report	/	Geometry done
PSBR8316	No issues to report	/	Geometry done
PSBR8317	No issues to report	/	Geometry done

PSBR8318	No issues to report	/	Geometry done
PSBR8319	No issues to report	/	Geometry done
PSBR8320	No issues to report	/	Geometry done
PSBR8321	No issues to report	/	Geometry done
PSBR900405	No seismic file	No possible solution	Cannot be reconstructed
PSBR8422	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
PSBR8423	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
PSBR8424	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
PSBR8425	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
PSBR8426	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
PSBR8427	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
PSBR8428	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
PSBR8429	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
PSBR8430	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
PSBR900404	No seismic file	No possible solution	Cannot be reconstructed
PSBR8501	FFID seismic doesn't match with FFID Observer log file but file names match	/	Cannot be reconstructed
PSBR8502	FFID seismic doesn't match with FFID Observer log file but file names match	Coordinate sources/receivers compute from CMP coordinates	Geometry done
PSBR8503	FFID seismic doesn't match with FFID Observer log file but file names match	/	Cannot be reconstructed
PSBR8504	FFID seismic doesn't match with FFID Observer log file but file names match	/	Cannot be reconstructed
PSBR8505	No seismic file	No possible solution	Cannot be reconstructed
PSBR8801	No issues to report	/	Geometry done
PSBR8802	No issues to report	/	Geometry done
PSBR8803	No issues to report	/	Geometry done
PSBR8804	No issues to report	/	Geometry done
PSBR8805	No issues to report	/	Geometry done
PSBR8806	No issues to report	/	Geometry done
PSBR900101B	No seismic file	No possible solution	Cannot be reconstructed
PSBR9001	No issues to report	/	Geometry done
PSBR900101	No issues to report	/	Geometry done
PSBR900102	Pseudo-marine	/	Geometry done
PSBR900103	Pseudo-marine	/	Geometry done
PSBR900201	Pseudo-marine	/	Geometry done
PSBR900202	Pseudo-marine	/	Geometry done
PSBR900301	Pseudo-marine	/	Geometry done
PSBR900302	Pseudo-marine	/	Geometry done
PSBR9004	No issues to report	/	Geometry done
PSBR900401	Pseudo-marine	/	Geometry done

PSBR900402	No issues to report	/	Geometry done
PSBR900403	Pseudo-marine	/	Geometry done
PSBR900503	Pseudo-marine	/	Geometry done
PSBR9005	No issues to report	/	Geometry done
PSBR900501	No issues to report	/	Geometry done
PSBR900502	Pseudo-marine	/	Geometry done
PSBR9006	Pseudo-marine	/	Geometry done
PSBR900601	Pseudo-marine	/	Geometry done
PSBR900602	No issues to report	/	Geometry done
PSBR900603	Pseudo-marine	/	Geometry done
PSBR9007	Short line	/	Geometry done
PSBR900701	No issues to report	/	Geometry done
PSBR900702	Pseudo-marine	/	Geometry done
PSBR900703	Pseudo-marine	/	Geometry done
PSBR900801	No issues to report	/	Geometry done
PSBR900801g	No receivers coordinate	No possible solution	Cannot be reconstructed
PSBR900802	Pseudo-marine	/	Geometry done
PSBR900803	Pseudo-marine	/	Geometry done
PSBR9009	No issues to report	/	Geometry done
PSBR900901	Pseudo-marine	/	Geometry done
PSBR900902	No seismic file	No possible solution	Cannot be reconstructed
PSBR9010g	No seismic file	No possible solution	Cannot be reconstructed
PSBR9010s	No seismic file	No possible solution	Cannot be reconstructed
PSBR9010	No receivers coordinate	No possible solution	Cannot be reconstructed
PSBR9011	Pseudo-marine	/	Geometry done
SADH650001-08	No navigation file	No possible solution	Cannot be reconstructed
SADH720007	Uncorrelated seismic data and no pilot trace	Correlation with a pilot trace (7s-48Hz)	Geometry done
SADH730001	Uncorrelated seismic data and no pilot trace	Correlation with a pilot trace (7s-48Hz)	Geometry done
SADH730002	Uncorrelated seismic data and no pilot trace	Correlation with a pilot trace (7s-48Hz)	Geometry done
SADH730003	Uncorrelated seismic data and no pilot trace	Correlation with a pilot trace (7s-48Hz)	Geometry done
SADH730004	Uncorrelated seismic data and no pilot trace	Correlation with a pilot trace (7s-48Hz)	Geometry done
SADH730005	Uncorrelated seismic data and no pilot trace	Correlation with a pilot trace (7s-48Hz)	Geometry done
SADH740008	FFID seismic doesn't match FFID Observer log file and no navigation file	Correspondence made based on the number of traces per shot, which is also reported in the obslog and coordinates sources/receivers compute from CMP coordinates	Geometry done
SADH740009	FFID seismic doesn't match FFID Observer log file and no navigation file	Correspondence made based on the number of traces per shot, which is also reported in the obslog and coordinates sources/receivers compute from CMP coordinates	Geometry done
SADH740010	FFID seismic doesn't match FFID Observer log file and no navigation file	Correspondence made based on the number of traces per shot, which is also reported in the obslog and coordinates sources/receivers compute from CMP coordinates	Geometry done
SADH740011	FFID seismic doesn't match	Correspondence made based on the	Geometry done

	FFID Observer log file and no navigation file	number of traces per shot, which is also reported in the obslog and coordinates sources/receivers compute from CMP coordinates	
SADH740012	FFID seismic doesn't match FFID Observer log file and no navigation file	Correspondence made based on the number of traces per shot, which is also reported in the obslog and coordinates sources/receivers compute from CMP coordinates	Geometry done
SADH740013	FFID seismic doesn't match FFID Observer log file and no navigation file	Correspondence made based on the number of traces per shot, which is also reported in the obslog and coordinates sources/receivers compute from CMP coordinates	Geometry done
SADH740014	FFID seismic doesn't match FFID Observer log file and no navigation file	Correspondence made based on the number of traces per shot, which is also reported in the obslog and coordinates sources/receivers compute from CMP coordinates	Geometry done
SADH760015	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
SADH760016	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
SADH760017	Line without Observer log file and no navigation file	Synthetic Observer log file and coordinates sources/receivers compute from CMP coordinates	Geometry done
SADH760018	Line without Observer log file and no navigation file	Synthetic Observer log file and coordinates sources/receivers compute from CMP coordinates	Geometry done
SADH770001	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
SADH770001	No seismic file	No possible solution	Cannot be reconstructed
SADH770002	Issues with CMP coordinates	No possible solution	Cannot be reconstructed
SADH770011	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
SADH770012	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
SADH770013	No navigation file	Coordinates source/receivers compute from CMP coordinates	Geometry done
SADH770014	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
SADH770015	No navigation file	Coordinates source/receivers compute from CMP coordinates	Geometry done
SADH770016	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
SADH770017	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
SADH770018	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
SADH780019	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
SADH780020	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done

SADH780021	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
SADH780022	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
SADH780023	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
SADH790024	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
SADH790025	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
SADH790026	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
SADH790027	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
SADH8401	No issues to report	/	Geometry done
SADH8402	No issues to report	/	Geometry done
SADH8403	No issues to report	/	Geometry done
SADH8601	No issues to report	/	Geometry done
SADH8602	No issues to report	/	Geometry done
SADH8603	No issues to report	/	Geometry done
SADH8604	No issues to report	/	Geometry done
SADH8605	No issues to report	/	Geometry done
SADH8606	No issues to report	/	Geometry done
SADH8607	No issues to report	/	Geometry done
SADH8608	No issues to report	/	Geometry done
V3-LaValle1972	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
V4-LaValle1972	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
VD2012_01	No issues to report	/	Geometry done
VD2012_02	No issues to report	/	Geometry done
VD2012_03	No issues to report	/	Geometry done
VD2012_04	Observer log shots missing (from sp 4086 to sp 4360)	Corrected based on the RMS map	Geometry done
VD2012_05	No issues to report	/	Geometry done
VD2012_06	No issues to report	/	Geometry done
VD2012_07	No issues to report	/	Geometry done
VD2012_08	No issues to report	/	Geometry done
VD2012_09	No issues to report	/	Geometry done
VD2012_10	No issues to report	/	Geometry done
VD2012_11	No issues to report	/	Geometry done
VD2012_12	No issues to report	/	Geometry done
VD-P730002	No issues to report	/	Geometry done
VD-P730003	No issues to report	/	Geometry done
VD-P730004	No issues to report	/	Geometry done
VD-P730008	No issues to report	/	Geometry done
VD-P730009	No issues to report	/	Geometry done
VD-P730010	No issues to report	/	Geometry done
VD-P730011	No issues to report	/	Geometry done
VD-P730012	No issues to report	/	Geometry done
VD-P730013	No issues to report	/	Geometry done
VD-P730014	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
VD-P730015	No issues to report	/	Geometry done

VD-P730016	No issues to report	/	Geometry done
VD-P730017	No issues to report	/	Geometry done
VD-P730018	No issues to report	/	Geometry done
VD-P730019	No issues to report	/	Geometry done
VD-P730020	No issues to report	/	Geometry done
VD-P730021	No issues to report	/	Geometry done
VD-P730022	No issues to report	/	Geometry done
VD-P730023	No issues to report	/	Geometry done
VD-P730024	No issues to report	/	Geometry done
VD-P730025	No issues to report	/	Geometry done
VD-P730026	Seismic data missing (from FFID 2753 to FFID 2772)	No possible solution	Geometry done
VD-P730027	Seismic data missing (from FFID 2773 to FFID 2782 and FFID 2834 to 2853)	No possible solution	Geometry done
VD-P730028	No issues to report	/	Geometry done
VD-P740032	No issues to report	/	Geometry done
VD-P740033	No issues to report	/	Geometry done
VD-P740040	No issues to report	/	Geometry done
VD-P740041	No issues to report	/	Geometry done
VD-P740042	No issues to report	/	Geometry done
VD-P740043	No issues to report	/	Geometry done
VD-P740044	No issues to report	/	Geometry done
VD-P740045	No issues to report	/	Geometry done
VD-P740046	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
VD-P740047	No navigation file	Coordinate sources/receivers compute from CMP coordinates	Geometry done
VD-P740048	No issues to report	/	Geometry done
VD-P740049	No issues to report	/	Geometry done
VD-P740050	No issues to report	/	Geometry done
VD-P740051	No issues to report	/	Geometry done
VD-P740053	Seismic data missing (from FFID 61 to FFID 108)	No possible solution	Geometry done
VD-P740054	No issues to report	/	Geometry done
VD-P750055	No issues to report	/	Geometry done
VD-P760059	No issues to report	/	Geometry done
VD-P760060	No issues to report	/	Geometry done
VD-P760063	No issues to report	/	Geometry done
VD-P760064	No issues to report	/	Geometry done
VD-P760067	Seismic data missing (from FFID 1 to FFID 151)	No possible solution	Geometry done
VD-P760070	Seismic data missing (from FFID 70 to FFID 200)	No possible solution	Geometry done
VD-P760071	No issues to report	/	Geometry done
VD-P760072	No issues to report	/	Geometry done
VD-P770002	No issues to report	/	Geometry done
VD-P770003	FFID seismic does not match FFID Obslog	Correspondence made based on the number of traces per shot, which is also reported in the obslog field	Geometry done
VD-P770004	No issues to report	/	Geometry done
VD-P770006	FFID seismic does not match FFID Obslog	Correspondence made based on the number of traces per shot, which is also reported in the obslog field	Geometry done

VD-P770008	No seismic file	No possible solution	Cannot be reconstructed
VD-P780073	FFID seismic does not match with FFID Obslog, and file names do not match	No possible solution	Cannot be reconstructed
VD-P780074	FFID seismic does not match with FFID Obslog, and file names do not match	No possible solution	Cannot be reconstructed
VD-P780075	FFID seismic does not match with FFID Obslog, and file names do not match	No possible solution	Cannot be reconstructed
VD-P780076	FFID seismic does not match with FFID Obslog, and file names do not match	No possible solution	Cannot be reconstructed
VD-P780077	FFID seismic does not match with FFID Obslog, and file names do not match	No possible solution	Cannot be reconstructed
VD-P780078	FFID seismic does not match with FFID Obslog, and file names do not match	No possible solution	Cannot be reconstructed
VD-P780079	FFID seismic does not match with FFID Obslog, and file names do not match	No possible solution	Cannot be reconstructed
VD-P780080	FFID seismic does not match with FFID Obslog, and file names do not match	No possible solution	Cannot be reconstructed
VD-P780081	FFID seismic does not match with FFID Obslog, and file names do not match	No possible solution	Cannot be reconstructed
16-SIL-01	No issues to report	/	Geometry done
16-SIL-02	No issues to report	/	Geometry done
16-SIL-03	No issues to report	/	Geometry done
16-SIL-04	No issues to report	/	Geometry done

Fig. 4.1 illustrates the location of these 230 lines, of which 193 have been reconstructed.

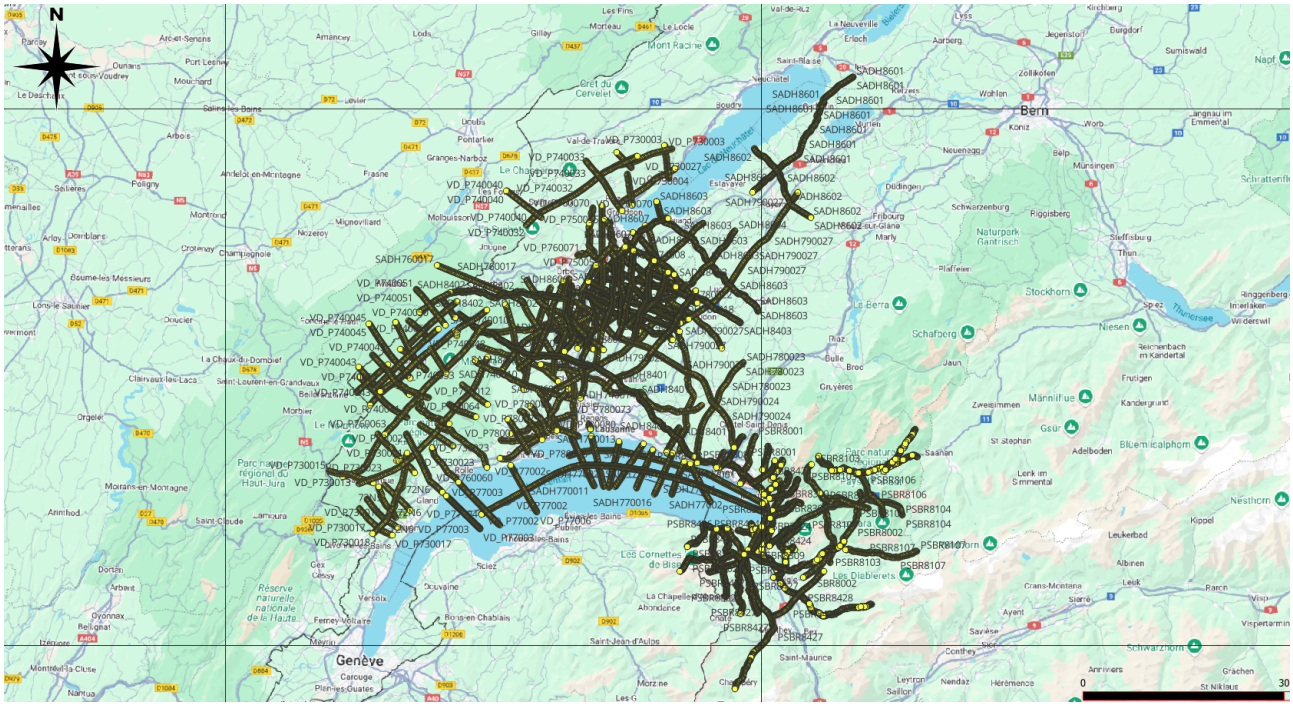


Fig. 4.1. Location map of the reconstructed 2D lines

Comments about the received data

- DATA: SEG-Y and SEGD

Seismic data is sorted in shot gathers.

As part of this project, we received: 202 seismic files out of 230. Thus, 28 lines were missing seismic data, 9 lines had seismic data that did not match the field observer logs, and 4 lines had uncorrelated seismic files.

- X, Y COORDINATES AND ELEVATION (Text, PDF, SPS files)

Coordinates and elevation data related to land acquisition are commonly stored in SPS (Shot Point Standard) and RPS (Receiver Point Standard) files, separately handling information for shots and receivers. SPS files hold details such as shot point numbers, X and Y coordinates, as well as shot elevation. Similarly, RPS files contain receiver point numbers, X and Y coordinates, and the corresponding receiver elevation. Nevertheless, in the previous century, this valuable data was documented on paper, necessitating laborious manual scanning and conversion efforts to transform it into digital formats suitable for analysis and processing.

During the course of this project, it was found that 90% of the coordinates and elevation files existed in PDF format, requiring significant efforts for digitization (taping) to convert them into usable digital data. The remaining documents were either in text format or already available in SPS files, which eased the processing and analysis tasks. In certain instances, the elevation data were missing from the original files. To address this, the available coordinates file served as a reference, allowing the extraction of elevation information from a digital elevation model (Suisse alti 3D).

We received 153 coordinate files (for sources or receivers), which means that 77 lines are missing navigation files for sources and/or receivers. However, we received 220 CMP files (these CMPs were not the true field CMPs, as they were extracted from previously processed lines), which allowed us to approximate the coordinates of the sources and receivers.

Example of data files :

- PSBR90021.sgy
- Observer-Fieldnotes_SADH780020.pdf
- NAV-Seis2D_data-CH-20161201.xlsx
- OBSERVER LOG <broken cross-reference>

- ACQUISITION REPORTS.

Information about all activities carried out during the seismic acquisition is recorded in the field *observer logs*. These files are expected to contain the relationship between the FFIDs, the shot point number, the receiver point number, the coordinates of the sources and receivers, the recording channels, as well as the elevations. This allows establishing correspondences between the seismic data and the navigation files. These relationships are carefully checked using RMS maps and LMO corrections, and adjusted if anomalies are detected.
In this project, we received 198 field *observer logs*, with the majority of the documents (90%) in PDF format, which were successfully digitized (10% were in XPS format). As a result, 32 lines lacked field *observer logs*, which required the creation of synthetic observer logs as specified in 3.3.2 Lines without observer logs.

4.2 Processing examples

An example of quality that was achieved by the raw PSTM migration is illustrated in Fig. 4.2 in the right-hand side panel. The comparison between left and right panel shows the effect of migration in the repositioning of collapsing the diffractions.

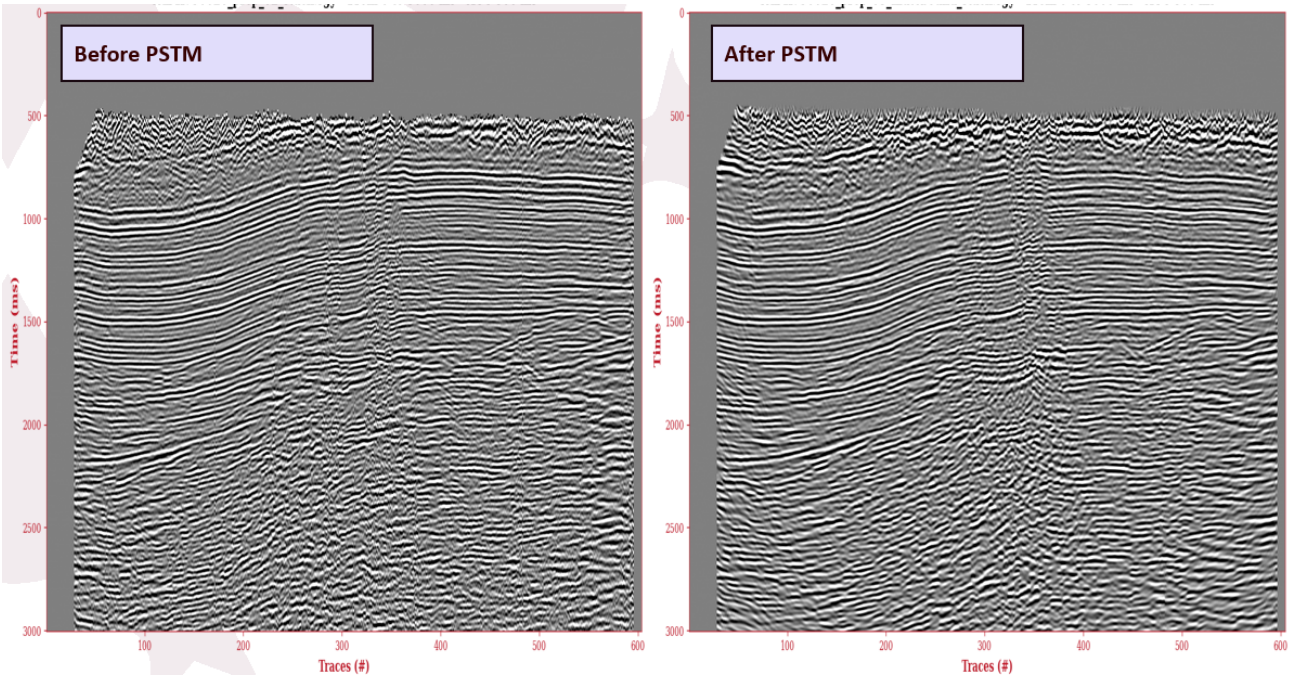


Fig. 4.2. Line SADH790026 stack Before and After migration at 1200 m datum
This comparison clearly demonstrates the efficiency of migration to collapse diffractions at the accurate locations.

The PSTMs are provided as an appendix.

4.3 List of Deliverables

The following files have been sent to Canton de Vaud as final deliverables:

Table 4.2. List of deliverables

Line name	Navmerge (SGY)	Geometry QC file (PPTX)	PSTM (PPTX)
72N5	CH_CANTON_DE_VAUD_72N5_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_72N5_Full_Field_QC.pptx	No
72N6	CH_CANTON_DE_VAUD_72N6_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_72N6_Full_Field_QC.pptx	No
ECL-12-01	CH_CANTON_DE_VAUD_ECL_12_01_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_ECL_12_01_Full_Field_QC.pptx	No
ECL-12-02	CH_CANTON_DE_VAUD_ECL_12_02_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_ECL_12_02_Full_Field_QC.pptx	No
ECL-12-03	CH_CANTON_DE_VAUD_ECL_12_03_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_ECL_12_03_Full_Field_QC.pptx	No
M1-Marchairuz1972	CH_CANTON_DE_VAUD_Marchairuz1972_M1_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_Marchairuz1972_M1_Full_Field_QC.pptx	No
M2-Marchairuz1972	CH_CANTON_DE_VAUD_Marchairuz1972_M2_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_Marchairuz1972_M2_Full_Field_QC.pptx	No
N93-WF-10	CH_CANTON_DE_VAUD_N93_WF_10_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_N93_WF_10_Full_Field_QC.pptx	No
N93-WS-20	CH_CANTON_DE_VAUD_N93_WS_20_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_N93_WS_20_Full_Field_QC.pptx	No
PSBR8001	CH_CANTON_DE_VAUD_PSBR8001_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8001_Full_Field_QC.pptx	No
PSBR8002	CH_CANTON_DE_VAUD_PSBR8002_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8002_Full_Field_QC.pptx	No
PSBR8103	CH_CANTON_DE_VAUD_PSBR8103_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8103_Full_Field_QC.pptx	No
PSBR8104	CH_CANTON_DE_VAUD_PSBR8104_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8104_Full_Field_QC.pptx	No
PSBR8105	CH_CANTON_DE_VAUD_PSBR8105_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8105_Full_Field_QC.pptx	No
PSBR8106	CH_CANTON_DE_VAUD_PSBR8106_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8106_Full_Field_QC.pptx	No
PSBR8107	CH_CANTON_DE_VAUD_PSBR8107_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8107_Full_Field_QC.pptx	No
PSBR8308	CH_CANTON_DE_VAUD_PSBR8308_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8308_Full_Field_QC.pptx	No
PSBR8309	CH_CANTON_DE_VAUD_PSBR8309_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8309_Full_Field_QC.pptx	No
PSBR8310	CH_CANTON_DE_VAUD_PSBR8310_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8310_Full_Field_QC.pptx	No
PSBR8311	CH_CANTON_DE_VAUD_PSBR8311_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8311_Full_Field_QC.pptx	No
PSBR8312	CH_CANTON_DE_VAUD_PSBR8312_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8312_Full_Field_QC.pptx	No
PSBR8313	CH_CANTON_DE_VAUD_PSBR8313_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8313_Full_Field_QC.pptx	No
PSBR8314	CH_CANTON_DE_VAUD_PSBR8314_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8314_Full_Field_QC.pptx	No
PSBR8315	CH_CANTON_DE_VAUD_PSBR8315_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8315_Full_Field_QC.pptx	No
PSBR8316	CH_CANTON_DE_VAUD_PSBR8316_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8316_Full_Field_QC.pptx	No
PSBR8317	CH_CANTON_DE_VAUD_PSBR8317_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8317_Full_Field_QC.pptx	No

PSBR8318	CH_CANTON_DE_VAUD_PSBR8318_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8318_Full_Field_QC.pptx	No
PSBR8319	CH_CANTON_DE_VAUD_PSBR8319_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8319_Full_Field_QC.pptx	No
PSBR8320	CH_CANTON_DE_VAUD_PSBR8320_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8320_Full_Field_QC.pptx	No
PSBR8321	CH_CANTON_DE_VAUD_PSBR8321_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8321_Full_Field_QC.pptx	No
PSBR8422	CH_CANTON_DE_VAUD_PSBR8422_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8422_Full_Field_QC.pptx	No
PSBR8423	CH_CANTON_DE_VAUD_PSBR8423_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8423_Full_Field_QC.pptx	No
PSBR8424	CH_CANTON_DE_VAUD_PSBR8424_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8424_Full_Field_QC.pptx	No
PSBR8425	CH_CANTON_DE_VAUD_PSBR8425_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8425_Full_Field_QC.pptx	No
PSBR8426	CH_CANTON_DE_VAUD_PSBR8426_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8426_Full_Field_QC.pptx	No
PSBR8427	CH_CANTON_DE_VAUD_PSBR8427_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8427_Full_Field_QC.pptx	Yes
PSBR8428	CH_CANTON_DE_VAUD_PSBR8428_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8428_Full_Field_QC.pptx	No
PSBR8429	CH_CANTON_DE_VAUD_PSBR8429_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8429_Full_Field_QC.pptx	No
PSBR8430	CH_CANTON_DE_VAUD_PSBR8430_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8430_Full_Field_QC.pptx	No
PSBR8502	CH_CANTON_DE_VAUD_PSBR8502_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8502_Full_Field_QC.pptx	No
PSBR8801	CH_CANTON_DE_VAUD_PSBR8801_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8801_Full_Field_QC.pptx	No
PSBR8802	CH_CANTON_DE_VAUD_PSBR8802_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8802_Full_Field_QC.pptx	No
PSBR8803	CH_CANTON_DE_VAUD_PSBR8803_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8803_Full_Field_QC.pptx	No
PSBR8804	CH_CANTON_DE_VAUD_PSBR8804_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8804_Full_Field_QC.pptx	No
PSBR8805	CH_CANTON_DE_VAUD_PSBR8805_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8805_Full_Field_QC.pptx	No
PSBR8806	CH_CANTON_DE_VAUD_PSBR8806_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR8806_Full_Field_QC.pptx	No
PSBR9001	CH_CANTON_DE_VAUD_PSBR9001_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR9001_Full_Field_QC.pptxYes	Yes
PSBR900101	CH_CANTON_DE_VAUD_PSBR900101_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900101_Full_Field_QC.pptx	No
PSBR900102	CH_CANTON_DE_VAUD_PSBR900102_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900102_Full_Field_QC.pptx	No
PSBR900103	CH_CANTON_DE_VAUD_PSBR900103_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900103_Full_Field_QC.pptx	No
PSBR900201	CH_CANTON_DE_VAUD_PSBR900201_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900201_Full_Field_QC.pptx	No
PSBR900202	CH_CANTON_DE_VAUD_PSBR900202_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900202_Full_Field_QC.pptx	No
PSBR900301	CH_CANTON_DE_VAUD_PSBR900301_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900301_Full_Field_QC.pptx	No

PSBR900302	CH_CANTON_DE_VAUD_PSBR900302_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900302_Full_Field_QC.pptx	No
PSBR9004	CH_CANTON_DE_VAUD_PSBR9004_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR9004_Full_Field_QC.pptx	No
PSBR900401	CH_CANTON_DE_VAUD_PSBR900401_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900401_Full_Field_QC.pptx	No
PSBR900402	CH_CANTON_DE_VAUD_PSBR900402_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900402_Full_Field_QC.pptx	No
PSBR900403	CH_CANTON_DE_VAUD_PSBR900403_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900403_Full_Field_QC.pptx	No
PSBR900503	CH_CANTON_DE_VAUD_PSBR900503_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900503_Full_Field_QC.pptx	No
PSBR9005	CH_CANTON_DE_VAUD_PSBR9005_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR9005_Full_Field_QC.pptx	No
PSBR900501	CH_CANTON_DE_VAUD_PSBR900501_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900501_Full_Field_QC.pptx	No
PSBR900502	CH_CANTON_DE_VAUD_PSBR900502_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900502_Full_Field_QC.pptx	No
PSBR9006	CH_CANTON_DE_VAUD_PSBR9006_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR9006_Full_Field_QC.pptx	No
PSBR900601	CH_CANTON_DE_VAUD_PSBR900601_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900601_Full_Field_QC.pptx	No
PSBR900602	CH_CANTON_DE_VAUD_PSBR900602_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900602_Full_Field_QC.pptx	No
PSBR900603	CH_CANTON_DE_VAUD_PSBR900603_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900603_Full_Field_QC.pptx	No
PSBR9007	CH_CANTON_DE_VAUD_PSBR9007_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR9007_Full_Field_QC.pptx	No
PSBR900701	CH_CANTON_DE_VAUD_PSBR900701_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900701_Full_Field_QC.pptx	No
PSBR900702	CH_CANTON_DE_VAUD_PSBR900702_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900702_Full_Field_QC.pptx	No
PSBR900703	CH_CANTON_DE_VAUD_PSBR900703_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900703_Full_Field_QC.pptx	No
PSBR900801	CH_CANTON_DE_VAUD_PSBR900801_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900801_Full_Field_QC.pptx	No
PSBR900802	CH_CANTON_DE_VAUD_PSBR900802_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900802_Full_Field_QC.pptx	No
PSBR900803	CH_CANTON_DE_VAUD_PSBR900803_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900803_Full_Field_QC.pptx	No
PSBR9009	CH_CANTON_DE_VAUD_PSBR9009_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR9009_Full_Field_QC.pptx	No
PSBR900901	CH_CANTON_DE_VAUD_PSBR900901_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR900901_Full_Field_QC.pptx	No
PSBR9011	CH_CANTON_DE_VAUD_PSBR90011_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_PSBR90011_Full_Field_QC.pptx	No
SADH730001	CH_CANTON_DE_VAUD_SADH73001_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH73001_Full_Field_QC.pptx	No
SADH730002	CH_CANTON_DE_VAUD_SADH73002_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH73002_Full_Field_QC.pptx	No
SADH730003	CH_CANTON_DE_VAUD_SADH73003_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH73003_Full_Field_QC.pptx	No
SADH730004	CH_CANTON_DE_VAUD_SADH73004_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH73004_Full_Field_QC.pptx	No

SADH730005	CH_CANTON_DE_VAUD_SADH73005_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH73005_Full_Field_QC.pptx	No
SADH740008	CH_CANTON_DE_VAUD_SADH74008_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH74008_Full_Field_QC.pptx	No
SADH740009	CH_CANTON_DE_VAUD_SADH74009_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH74009_Full_Field_QC.pptx	No
SADH740010	CH_CANTON_DE_VAUD_SADH740010_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH740010_Full_Field_QC.pptx	No
SADH740011	CH_CANTON_DE_VAUD_SADH740011_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH740011_Full_Field_QC.pptx	No
SADH740012	CH_CANTON_DE_VAUD_SADH740012_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH740012_Full_Field_QC.pptx	No
SADH740013	CH_CANTON_DE_VAUD_SADH740013_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH740013_Full_Field_QC.pptx	No
SADH740014	CH_CANTON_DE_VAUD_SADH740014_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH740014_Full_Field_QC.pptx	No
SADH760015	CH_CANTON_DE_VAUD_SADH760015_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH760015_Full_Field_QC.pptx	No
SADH760016	CH_CANTON_DE_VAUD_SADH760016_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH760016_Full_Field_QC.pptx	No
SADH760017	CH_CANTON_DE_VAUD_SADH760017_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH760017_Full_Field_QC.pptx	No
SADH760018	CH_CANTON_DE_VAUD_SADH760018_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH760018_Full_Field_QC.pptx	No
SADH770002	CH_CANTON_DE_VAUD_SADH77002_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH77002_Full_Field_QC.pptx	No
SADH770001	CH_CANTON_DE_VAUD_SADH77001_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH77001_Full_Field_QC.pptx	No
SADH770011	CH_CANTON_DE_VAUD_SADH770011_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH770011_Full_Field_QC.pptx	No
SADH770012	CH_CANTON_DE_VAUD_SADH770012_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH770012_Full_Field_QC.pptx	No
SADH770013	CH_CANTON_DE_VAUD_SADH770013_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH770013_Full_Field_QC.pptx	No
SADH770014	CH_CANTON_DE_VAUD_SADH770014_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH770014_Full_Field_QC.pptx	No
SADH770015	CH_CANTON_DE_VAUD_SADH770015_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH770015_Full_Field_QC.pptx	No
SADH770016	CH_CANTON_DE_VAUD_SADH770016_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH770016_Full_Field_QC.pptx	No
SADH770017	CH_CANTON_DE_VAUD_SADH770017_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH770017_Full_Field_QC.pptx	No
SADH770018	CH_CANTON_DE_VAUD_SADH770018_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH770018_Full_Field_QC.pptx	No
SADH780019	CH_CANTON_DE_VAUD_SADH780019_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH780019_Full_Field_QC.pptx	No
SADH780020	CH_CANTON_DE_VAUD_SADH780020_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH780020_Full_Field_QC.pptx	No
SADH780021	CH_CANTON_DE_VAUD_SADH780021_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH780021_Full_Field_QC.pptx	No
SADH780022	CH_CANTON_DE_VAUD_SADH780022_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH780022_Full_Field_QC.pptx	No
SADH780023	CH_CANTON_DE_VAUD_SADH780023_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH780023_Full_Field_QC.pptx	No

SADH790024	CH_CANTON_DE_VAUD_SADH790024_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH790024_Full_Field_QC.pptx	No
SADH790025	CH_CANTON_DE_VAUD_SADH790025_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH790025_Full_Field_QC.pptx	No
SADH790026	CH_CANTON_DE_VAUD_SADH790026_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH790026_Full_Field_QC.pptx	Yes
SADH790027	CH_CANTON_DE_VAUD_SADH790027_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH790027_Full_Field_QC.pptx	Yes
SADH8401	CH_CANTON_DE_VAUD_SADH8401_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH8401_Full_Field_QC.pptx	No
SADH8402	CH_CANTON_DE_VAUD_SADH8402_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH8402_Full_Field_QC.pptx	No
SADH8403	CH_CANTON_DE_VAUD_SADH8403_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH8403_Full_Field_QC.pptxYes	Yes
SADH8601	CH_CANTON_DE_VAUD_SADH8601_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH8601_Full_Field_QC.pptx	No
SADH8602	CH_CANTON_DE_VAUD_SADH8602_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH8602_Full_Field_QC.pptx	No
SADH8603	CH_CANTON_DE_VAUD_SADH8603_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH8603_Full_Field_QC.pptx	No
SADH8604	CH_CANTON_DE_VAUD_SADH8604_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH8604_Full_Field_QC.pptx	No
SADH8605	CH_CANTON_DE_VAUD_SADH8605_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH8605_Full_Field_QC.pptx	No
SADH8606	CH_CANTON_DE_VAUD_SADH8606_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH8606_Full_Field_QC.pptx	No
SADH8607	CH_CANTON_DE_VAUD_SADH8607_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH8607_Full_Field_QC.pptx	No
SADH8608	CH_CANTON_DE_VAUD_SADH8608_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_SADH8608_Full_Field_QC.pptx	No
V3-LaValle1972	CH_CANTON_DE_VAUD_LaValle1972_V3_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_LaValle1972_V3_Full_Field_QC.pptx	No
V4-LaValle1972	CH_CANTON_DE_VAUD_LaValle1972_V4_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_LaValle1972_V4_Full_Field_QC.pptx	No
VD2012_01	CH_CANTON_DE_VAUD_VD2012_01_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD2012_01_Full_Field_QC.pptx	No
VD2012_02	CH_CANTON_DE_VAUD_VD2012_02_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD2012_02_Full_Field_QC.pptx	No
VD2012_03	CH_CANTON_DE_VAUD_VD2012_03_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD2012_03_Full_Field_QC.pptx	No
VD2012_04	CH_CANTON_DE_VAUD_VD2012_04_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD2012_04_Full_Field_QC.pptx	No
VD2012_05	CH_CANTON_DE_VAUD_VD2012_05_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD2012_05_Full_Field_QC.pptx	No
VD2012_06	CH_CANTON_DE_VAUD_VD2012_06_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD2012_06_Full_Field_QC.pptx	No
VD2012_07	CH_CANTON_DE_VAUD_VD2012_07_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD2012_07_Full_Field_QC.pptx	No
VD2012_08	CH_CANTON_DE_VAUD_VD2012_08_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD2012_08_Full_Field_QC.pptx	No
VD2012_09	CH_CANTON_DE_VAUD_VD2012_09_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD2012_09_Full_Field_QC.pptx	No
VD2012_10	CH_CANTON_DE_VAUD_VD2012_10_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD2012_10_Full_Field_QC.pptx	No

VD2012_11	CH_CANTON_DE_VAUD_VD2012_11_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD2012_11_Full_Field_QC.pptx	No
VD2012_12	CH_CANTON_DE_VAUD_VD2012_12_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD2012_12_Full_Field_QC.pptx	No
VD-P730002	CH_CANTON_DE_VAUD_VD_P730002_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P730002_Full_Field_QC.pptx	No
VD-P730003	CH_CANTON_DE_VAUD_VD_P730003_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P730003_Full_Field_QC.pptx	No
VD-P730004	CH_CANTON_DE_VAUD_VD_P730004_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P730004_Full_Field_QC.pptx	No
VD-P730008	CH_CANTON_DE_VAUD_VD_P73008_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P73008_Full_Field_QC.pptx	No
VD-P730009	CH_CANTON_DE_VAUD_VD_P73009_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P73009_Full_Field_QC.pptx	No
VD-P730010	CH_CANTON_DE_VAUD_VD_P730010_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P730010_Full_Field_QC.pptx	No
VD-P730011	CH_CANTON_DE_VAUD_VD_P730011_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P730011_Full_Field_QC.pptx	No
VD-P730012	CH_CANTON_DE_VAUD_VD_P730012_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P730012_Full_Field_QC.pptx	No
VD-P730013	CH_CANTON_DE_VAUD_VD_P730013_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P730013_Full_Field_QC.pptx	No
VD-P730014	CH_CANTON_DE_VAUD_VD_P730014_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P730014_Full_Field_QC.pptx	No
VD-P730015	CH_CANTON_DE_VAUD_VD_P730015_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P730015_Full_Field_QC.pptx	No
VD-P730016	CH_CANTON_DE_VAUD_VD_P730016_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P730016_Full_Field_QC.pptx	No
VD-P730017	CH_CANTON_DE_VAUD_VD_P730017_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P730017_Full_Field_QC.pptx	No
VD-P730018	CH_CANTON_DE_VAUD_VD_P730018_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P730018_Full_Field_QC.pptx	No
VD-P730019	CH_CANTON_DE_VAUD_VD_P730019_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P730019_Full_Field_QC.pptx	No
VD-P730020	CH_CANTON_DE_VAUD_VD_P730020_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P730020_Full_Field_QC.pptx	No
VD-P730021	CH_CANTON_DE_VAUD_VD_P730021_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P730021_Full_Field_QC.pptx	No
VD-P730022	CH_CANTON_DE_VAUD_VD_P730022_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P730022_Full_Field_QC.pptx	No
VD-P730023	CH_CANTON_DE_VAUD_VD_P730023_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P730023_Full_Field_QC.pptx	No
VD-P730024	CH_CANTON_DE_VAUD_VD_P730024_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P730024_Full_Field_QC.pptx	No
VD-P730025	CH_CANTON_DE_VAUD_VD_P730025_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P730025_Full_Field_QC.pptx	No
VD-P730026	CH_CANTON_DE_VAUD_VD_P730026_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P730026_Full_Field_QC.pptx	No
VD-P730027	CH_CANTON_DE_VAUD_VD_P730027_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P730027_Full_Field_QC.pptx	No
VD-P730028	CH_CANTON_DE_VAUD_VD_P730028_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P730028_Full_Field_QC.pptx	No
VD-P740032	CH_CANTON_DE_VAUD_VD_P740032_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P740032_Full_Field_QC.pptx	No

VD-P740033	CH_CANTON_DE_VAUD_VD_P740033_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P740033_Full_Field_QC.pptx	No
VD-P740040	CH_CANTON_DE_VAUD_VD_P740040_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P740040_Full_Field_QC.pptx	No
VD-P740041	CH_CANTON_DE_VAUD_VD_P740041_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P740041_Full_Field_QC.pptx	No
VD-P740042	CH_CANTON_DE_VAUD_VD_P740042_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P740042_Full_Field_QC.pptx	No
VD-P740043	CH_CANTON_DE_VAUD_VD_P740043_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P740043_Full_Field_QC.pptx	No
VD-P740044	CH_CANTON_DE_VAUD_VD_P740044_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P740044_Full_Field_QC.pptx	No
VD-P740045	CH_CANTON_DE_VAUD_VD_P740045_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P740045_Full_Field_QC.pptx	No
VD-P740046	CH_CANTON_DE_VAUD_VD_P740046_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P740046_Full_Field_QC.pptx	No
VD-P740047	CH_CANTON_DE_VAUD_VD_P740047_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P740047_Full_Field_QC.pptx	No
VD-P740048	CH_CANTON_DE_VAUD_VD_P740048_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P740048_Full_Field_QC.pptx	No
VD-P740049	CH_CANTON_DE_VAUD_VD_P740049_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P740049_Full_Field_QC.pptx	No
VD-P740050	CH_CANTON_DE_VAUD_VD_P740050_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P740050_Full_Field_QC.pptx	No
VD-P740051	CH_CANTON_DE_VAUD_VD_P740051_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P740051_Full_Field_QC.pptx	No
VD-P740053	CH_CANTON_DE_VAUD_VD_P740053_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P740053_Full_Field_QC.pptx	No
VD-P740054	CH_CANTON_DE_VAUD_VD_P740054_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P740054_Full_Field_QC.pptx	No
VD-P750055	CH_CANTON_DE_VAUD_VD_P750055_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P750055_Full_Field_QC.pptx	Yes
VD-P760059	CH_CANTON_DE_VAUD_VD_P760059_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P760059_Full_Field_QC.pptx	No
VD-P760060	CH_CANTON_DE_VAUD_VD_P760060_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P760060_Full_Field_QC.pptx	No
VD-P760063	CH_CANTON_DE_VAUD_VD_P760063_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P760063_Full_Field_QC.pptx	No
VD-P760064	CH_CANTON_DE_VAUD_VD_P760064_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P760064_Full_Field_QC.pptx	Yes
VD-P760067	CH_CANTON_DE_VAUD_VD_P760067_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P760067_Full_Field_QC.pptx	Yes
VD-P760070	CH_CANTON_DE_VAUD_VD_P760070_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P760070_Full_Field_QC.pptx	No
VD-P760071	CH_CANTON_DE_VAUD_VD_P760071_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P760071_Full_Field_QC.pptx	No
VD-P760072	CH_CANTON_DE_VAUD_VD_P760072_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P760072_Full_Field_QC.pptx	No
VD-P770002	CH_CANTON_DE_VAUD_VD_P77002_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P77002_Full_Field_QC.pptx	Yes
VD-P770003	CH_CANTON_DE_VAUD_VD_P77003_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P77003_Full_Field_QC.pptx	No
VD-P770004	CH_CANTON_DE_VAUD_VD_P77004_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P77004_Full_Field_QC.pptx	No

VD-P770006	CH_CANTON_DE_VAUD_VD_P77006_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_VD_P77006_Full_Field_QC.pptx	No
16-SIL-01	CH_CANTON_DE_VAUD_16_SIL_01_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_16_SIL_01_Full_Field_QC.pptx	No
16-SIL-02	CH_CANTON_DE_VAUD_16_SIL_02_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_16_SIL_02_Full_Field_QC.pptx	No
16-SIL-03	CH_CANTON_DE_VAUD_16_SIL_03_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_16_SIL_03_Full_Field_QC.pptx	Yes
16-SIL-04	CH_CANTON_DE_VAUD_16_SIL_04_NavMerge.sgy	CH_CANTON_DE_VAUD_GEOMETRY_BUILD_16_SIL_04_Full_Field_QC.pptx	No

In addition RTS provided a location map for all the lines, a quality control (QC) of the line elevations, and a summary table of the line diagnostics.

5 CONCLUSION

The company Realtimeseismic (RTS) was commissioned by the Canton de Vaud to reconstruct 230 2D seismic lines located in Switzerland around the city of Lausanne. The objective of reconstructing these lines is to enhance the understanding of the deep geothermal potential targeted by the Canton de Vaud project.

A total of193 have been reconstructed, covering a total length of 2152 km. 37 could not be reconstructed lines, mainly because seismic data was missing (35 without seismic data and 2 without coordinates). Seismic data from 40 years ago did not always contain geometry information, complicating their reconstruction. The manual digitization of these data, often sourced from paper documents, is a tedious process prone to errors, particularly regarding elevations. Digital terrain models were used to overcome missing elevation data. The reconstruction sequence is summarized in Fig. 3.2.

RTS delivered the following deliverables:

- A diagnostic summary file for the 230 lines
- Seismic files with the geometry of the 193 reconstructed lines
- Quality control (QC) files for the geometry of the reconstructed lines
- Location of the lines
- A final report of the work completed

The challenges encountered were related to:

- Seismic data missing
- Pilot traces missing for uncorrelated data
- Field observation logs missing
- The divergence between the information from the seismic data and the field observation logs
- A seismic file for more than one line (thus double FFID)
- The twisted geometry of acquisition lines in the absence of true coordinates for sources and receivers

RTS applied the following solutions:

- Synthetic pilot traces for shots without pilot traces
- Synthetic observation logs for lines without field observation logs
- Separation of double FFID or elimination based on the line
- Extraction of coordinates from CMP for lines without navigation files
- Use of a digital elevation model for lines without elevation

Limitations

The workflow used by RTS enables the reconstruction of geometries, including addressing missing or incorrect information. Therefore, geometry errors may remain.

This is especially the case for lines for which field observation logs or navigation files were missing. In these cases the geometry remains approximate or does not reflect the actual conditions on the ground. This can lead to some issues during the processing of these lines, such as:

- Misalignments in gathers (CSG or CRG)
- Incorrect tomographic models
- Ineffective primary statics
- Cycle skips
- Inconsistent amplitudes within trace groups

- Misplacement of receivers or sources, causing migration artifacts

To better manage the issue with these problematic lines, it will be necessary to perform the processing while simultaneously correcting the geometry. These types of corrections are usual for reprocessing of onshore seismic data.

Considerations for future processing
In spite of the potential remaining geometry errors, the recovered data are still valuable, and reacquiring them would be very costly. Analyzing the data reveals that some are deemed well-exploitable. Overall, these data seem usable, and reprocessing could likely enhance their quality. With today's technological advancements and greater computational power, reprocessing old images is often beneficial, allowing for new insights or higher-quality images. Therefore, if there are areas of interest, reprocessing and reanalyzing the data would be very useful. Here are the reasons for considering reprocessing:

- **Quality improvement**: Technological advances allow old data to benefit from reprocessing, resulting in clearer and more detailed images.
- **New information**: Reprocessing data can reveal information that was not accessible during the initial analysis.
- **Error correction**: Reprocessing allows for the identification and correction of errors present in old data, thus improving reliability.
- **Creation of a historical database**: It helps establish a robust database for long-term studies on seismic and geological trends.
- **Improvement of geological modeling**: Better-processed data enhance the modeling of geological structures, facilitating the understanding of underlying formations and their potential behavior.
- **Reduced cost**: Reprocessing is less costly than acquiring new data.

When selecting lines to reprocess, the quality of the data will have to be taken in consideration. It was noted that the acquisition dating prior to 1990 presented many transcription issues as well as a low signal-to-noise ratio.

6 LIST OF ACRONYMS

Table 6.1. List of acronyms

QC	Quality Control
CRS	Coordinate Reference System
FFID	Field File Identification Number
CDP	Common Depth Point
CIG	Common Image Gather
CIP	Common Image Point
CMP	Common Mid-Point
COG	Common Offset Gather
CRG	Common Receiver Gather
CRS	Coordinate Reference System
CSG	Common Shot Gather
EPSG	European Petroleum Survey Group
FB	First Break
LMO	Linear Move-Out
PSTM	Pre-Stack Time Migration
RTS	Real Time Seismic
CV	Canton de Vaud