Remasterization – Physical Collection Recovery

Autor : Jandira Correia

Periteu Miguel

Data : 20.05.2021

Geolander
Geologia, Geofísica e Engenharia

Agenda

- Tape Transcription and Remastering
- Why Tape?
- Why Disk?
- Legacy Media Tape
- Modern Tape Storage
- Seismic Tape Ratios
- Common causes of tape failure and data loss
- Case Study-PRECAM
- Conclusion
- Questions

Geolander
Geologia, Geofísica e Engenharia

Tape Transcription and Remastering

Tape transcription and remastering mitigates one of today's biggest oil and gas data management challenges – the vast amount of different media and data formats used throughout the history of subsurface exploration.

- Physical storage volumes are eliminated.
- The threat of technological obsolescence is removed.
- The risk of data loss is mitigated.
- Reduce tape library inventory and maximize new media usage.
- Improve turnaround time for batch jobs depending on tape data sets.

Geolander
Geologia, Geofísica e Engenharia

Why Tape?

- Digital magnetic tape has been the primary technology for the acquisition and exchange of E&P data (especially seismic) since the 1960s.
- Most industry standard formats for seismic and well data are tape-based.
- Tape is a “passive” storage media – there is little in the way of electronics or moving parts that are likely to fail, tape stable over decades.
- Tape is a dumb system- unlikely be accidentally erased.
- Disk has significantly higher read/write bit error rates than tape.
- Tapes can be stored at low cost for many years and accessed when/if required.

Geolander
Geologia, Geofísica e Engenharia

Why Disk?

For long term storage of large seismic data volumes, tape is favoured over disk.

- Accessing data that is stored on disk is more intuitive for most users, and more relevant to many modern software applications.
- Disk is ideal for random access of data – you can readily and quickly jump from one file to another.
- Data can easily be copied from server storage to exchange storage (CD-ROM, HDD-USB) without the need for special software or tools.
- Data on disk is structured (names, folders) and can readily be modified, renamed, moved, copied, protected.

Geolander
Geologia, Geofísica e Engenharia

Legacy Media Types

- **9 & 21 Track Open Reel Tapes** – Used extensively in the oil and gas industry for geophysical exploration in the 1960s and 1970s, Capacity 120MB.

- **8mm Exabyte** – The Exabyte format became popular in the oil and gas sector during the 1980s and 1990s because of its relatively low-cost drives and tape media. The oil and gas industry's usage of this media was seen mainly in processed seismic data and well logs.

- **3480, 3490, 3490E Cartridge Tapes** – Released in the early 1980s, 3480 data storage was the first of a long line of robust cartridge format tape drives and media types, Capacity 200MB to 800 MB.

- **3590 B/E/H Tape Drive** – IBM's flagship since 1996, capacity around 10GB to 20GB this enterprise technology is extremely versatile and robust. The main issue for this media in today's terms is that it is very low capacity and the drives are starting to become harder to find.

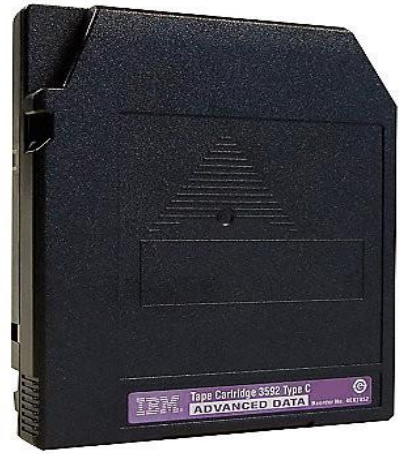
Geolander
Geologia, Geofísica e Engenharia

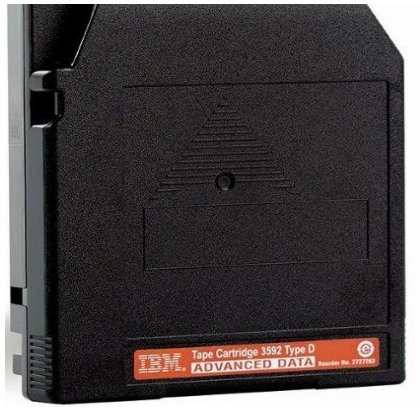
Modern Tape Media Storage for Seismic Data

- **LTO – Linear Tape Open –LTO** is one of the market leaders with seismic tape media capacities. While robust and high speed. LTO-9 offers the latest in LTO technology and delivers increased tape cartridge capacity with up to 18 TB (45 TB* compressed).

- **3592 Tape Drive** – This is IBM's blended technology. Its inner workings and tape mechanisms are a mix of technologies found in 3590 and LTO drives. This is an excellent all-around performer and is highly recommended for seismic data storage, if budget permits.

- **Disk** – Providing that the correct hard disk solution is put in place for the correct seismic data storage application, a hard disk can be a much more effective solution than tape media. For some reason, and unlike conventional tape storage media, hard disks tend to be poorly labeled and documented for in-house tracking.





Geolander
Geologia, Geofísica e Engenharia

Common causes of tape failure and data loss

- **Corruption**: operational error, expired tapes, mishandling of the tape or accidental overwrites caused inserting or partially formatting the wrong tape.

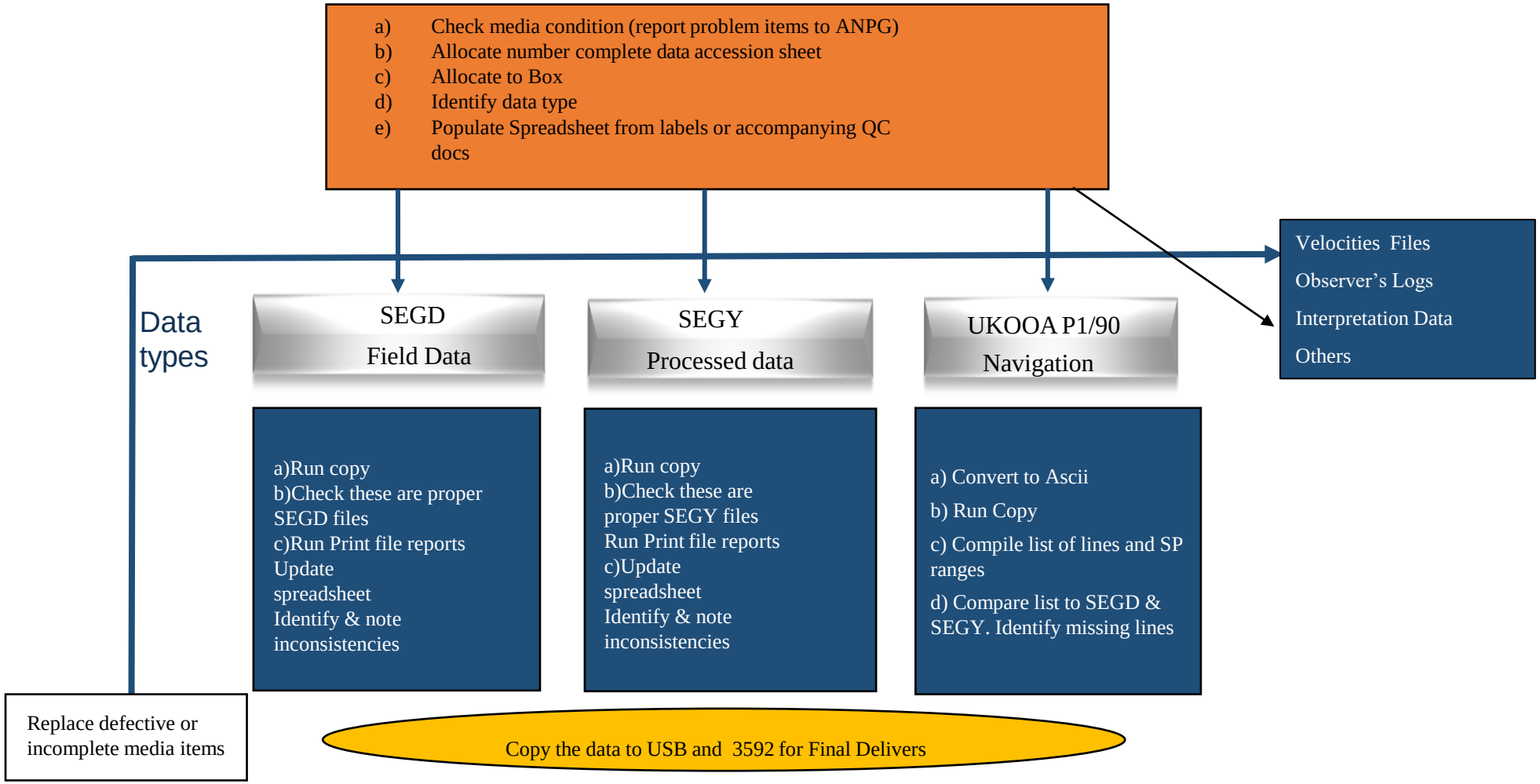
- **Physical Damage**: broken tapes, dirty drives and damage caused by fire, flood or other natural disaster.

- **Software Upgrades**: inability for data on tape to be read by new application or servers, technological obsolesce.

Geolander
Geologia, Geofísica e Engenharia

Case Study-PRECAM

PRECAM refers to the project of remastering the discontinued cartridges of the Agência Nacional de Petróleo, Gás e Biocombustíveis.



Geolander
Geologia, Geofísica e Engenharia

Cartridge inventory

The cartridge inventory process consists of a continuous process that starts at begin of project and extends to its completion.

The numbers presented at this point correspond to the total recorded in the ANGP offices so far, Sonangol EP and Luanda Refinery (Caroteca).

- Sonangol EP →**21 401** Tapes.
- Luanda Refinery (Caroteca) →**53 229** Tapes.

The estimated total of cartridges so far **74 630** Tapes.

Geolander
Geologia, Geofísica e Engenharia

Cartridge inventory

For the deployment of the project the below steps are following:

Separation of tapes by type of device:

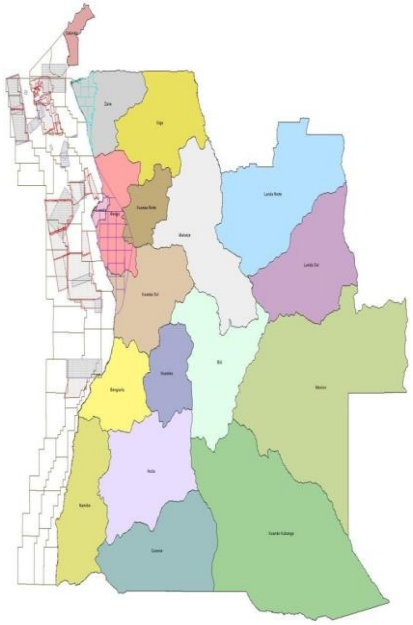
Ex: **DLT; 3480; 3590; 8MM**

Grouping according to the survey type:

Ex: **Block 6; Block 18; Block 32**

Grouping according to the format of the data:

Ex: **Seg-Y; Seg-D; UKOOA, P1/84; P1/90**

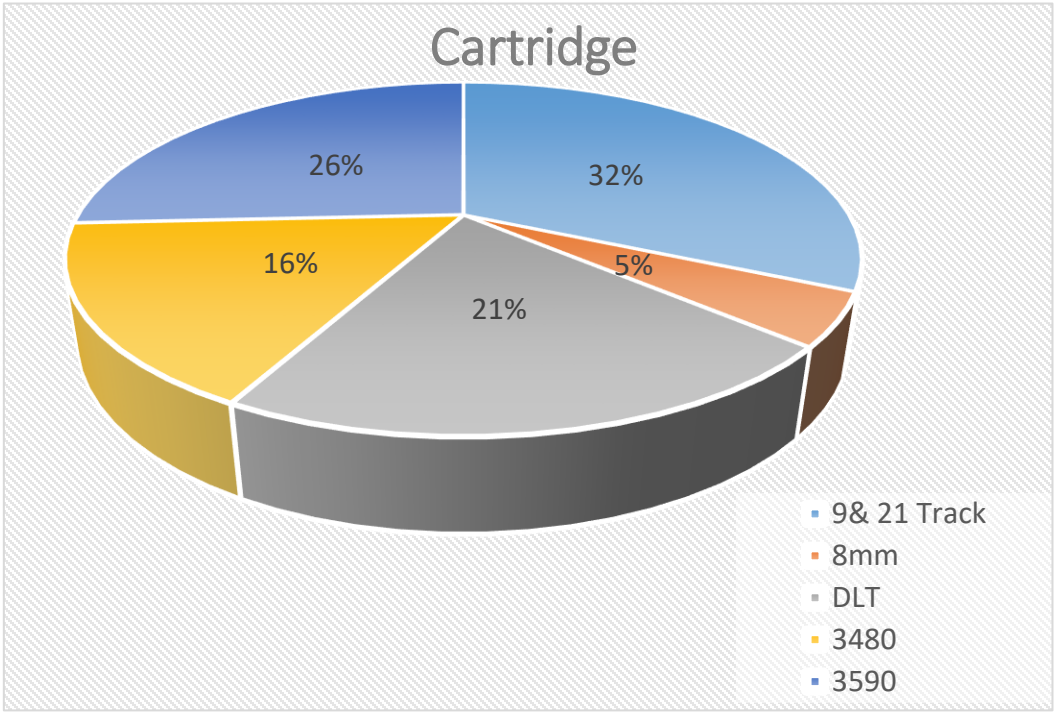


Additional data such as data ordering(**Shots, CMP, Near Trace**); stage (**Pre or Post Migration**) and processing year are also collected.

Geolander
Geologia, Geofísica e Engenharia

Cartridge Format

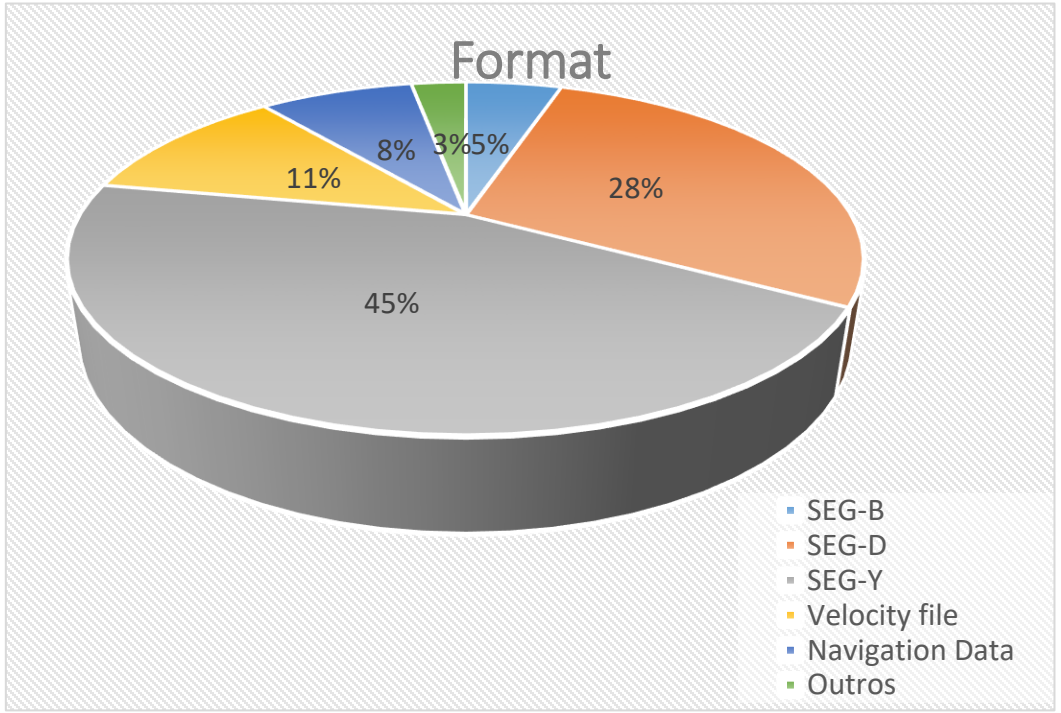
Cartridge	N Tapes	Total Size
9 and 21 Track	23752	**23 TB**
8MM	3563	**17 TB**
DLT	15785	**539 TB**
3480	12300	**98 TB**
3590	19230	**338 TB**



Geolander
Geologia, Geofísica e Engenharia

Cartridge Format

SEG-B	Field data , both 2D & 3D,
SEG-D	Field data , both 2D & 3D,
SEGY	Processed data 2D & 3D.
Navigation Files	P191, P184, P291, UKOOA.
Velocity File	Stacking and migration velocity data.



Geolander
Geologia, Geofísica e Engenharia

Data Validation and Quality Control

After completing the transcription , we perform critical validation activities and ensure the output data is clean, correct and useful. Validation and quality control includes:

- Tape status report for quality control pass and fail with explanation for deficiencies.
- Summary report for each output media and file, listing total files and associated details
- Detailed written report
- Text file with the EBCDIC header for each SEG-Y file
- Check the Coordinates X and Y
- Shot Gathers and 2D Stacks for pre- Migration Data.
- Fold Of Coverage
- Inline, Crossline and Timeslice for all 3D Data

Geolander
Geologia, Geofísica e Engenharia

Headers Quality Control

Text Header

```
C 2 LINE 2313P1-002  AREA  BLOCK6, ANGOLA          WRITTEN: SEPT 2007
C 3 DATA TYPE: NAV-SEIS MERGE SHOT GATHERS.
C 4 DATA SHOT BY: R/V WESTERN PRIDE  CABLE LENGTH: 6000M  GROUPS: 478
C 5 NO OF CABLES: 8   SOURCE: 2 X 5085 CU.IN   POP INTERVAL: 25M
C 6 GROUP INTERVAL: 12.5 M   RECORD LENGTH: 8192 MS   SAMPLE RATE: 2 MS
C 7 RECORDING FILTER(HZ/DB):LO-CUT 3/18,HI-CUT 200/477. INSTRUMENT DELAY:0
C 8 WATER VELOCITY:1496M/S NOMINAL FIRST TRACE OFFSET: 170 M
C 9 GEODETIC DATUM: WGS-84   SPHEROID: WGS-84   PROJECTION: UTM SOUTH
C10 CENTRAL MERIDIAN: 15DEG EAST  FALSE EASTING:500000, FALSE NORTHING:10000000
C11 NAVIGATION: TRINAV DGPS.  GRID PARAMETERS - SURVEY BLOCK6
C12 CELL SIZE: 25 M X 6.25 M (INL,XL), INLINE AZIMUTH: 270.259 DEGREES
C13 GRID ORIG (INL1,XL1): X:320505.60 Y:8991871.20
C14 PROCESSING GRID CORNERS - SURVEY BLOCK6
C15 1:INL:1    XL:1    X:320505.6 Y:8991871.2 090659.114S 0132159.910E
C16 2:INL:1    XL:12001 X:245505.6 Y:8991871.2 090645.785S 0124104.148E
C17 3:INL:2501  XL:1    X:320505.6 Y:9054371.2 083304.782S 0132208.860E
C18 4:INL:2501  XL:12001 X:245505.6 Y:9054371.2 083252.291S 0124116.829E
C19
C20
C21 ********************PROCESSING SEQUENCE**********************
C22 REFORMAT SEG-D
C23 NAV-SEISMIC MERGE
C24 ASSIGN TRACES TO 3-D GRID CELLS
C25 FLAG ONLINE OBSERVED SHOT AND TRACE EDITS
C26 OUTPUT TO SEG-Y FORMAT       (DATA SAMPLE FORMAT: 32_BIT_IBM_FLOATING)
C27 TRACE HEADER BYTE POSITION:
C28 SHOTPOINT          17- 20 4I          OFFSET          37- 40 4I
C29 DETECTOR DEPTH     41- 44 4I          SOURCE DEPTH    49- 52 4I
C30 WBOT-DEPTH-SRC     61- 64 4I          WBOT-DEPTH-DETECTOR  65- 68 4I
C31 XCORD SOURCE       73- 76 4I          YCORD SOURCE    77- 80 4I
C32 XCORD DETECTOR     81- 84 4I          YCORD DETECTOR  85- 88 4I
C33 YEAR DATA RECORDED  157-158 2I        JULIAN DAY OF YEAR  159-160 2I
```

Trace Header

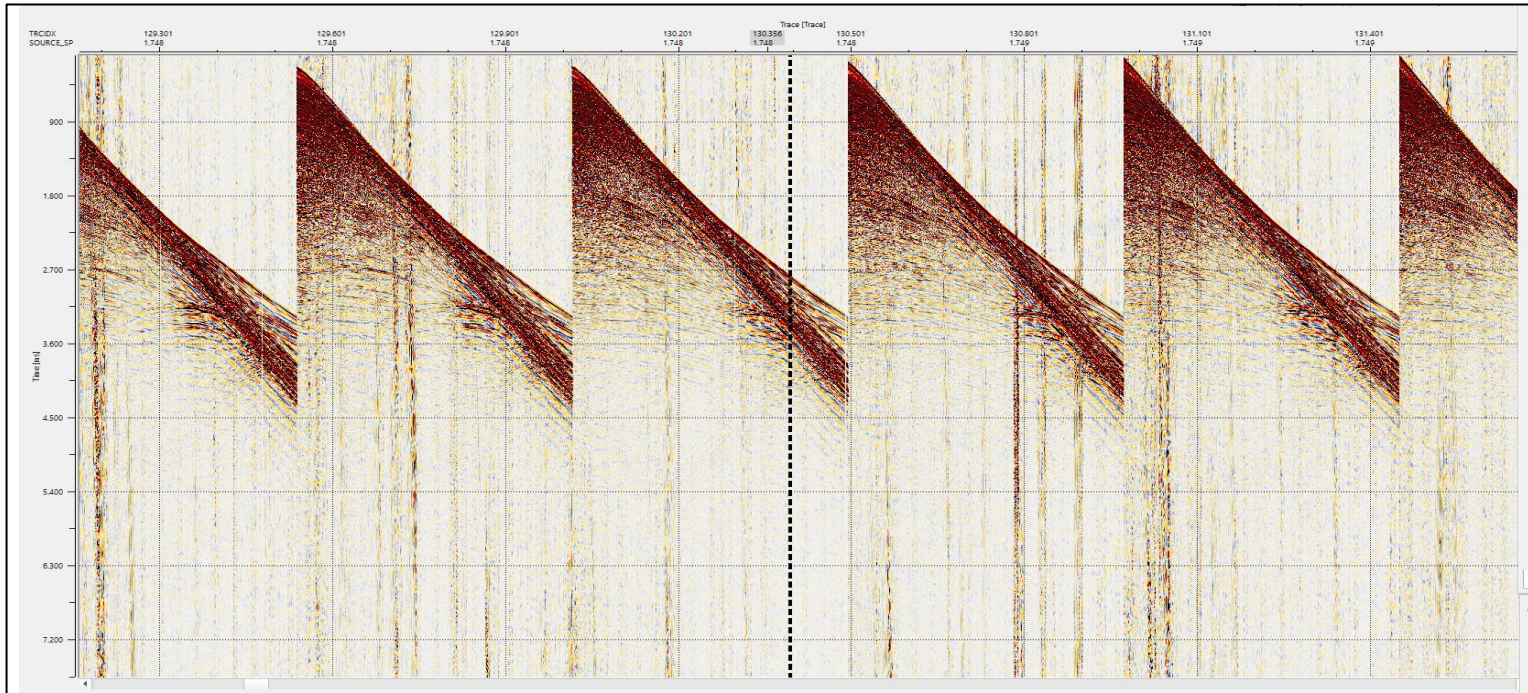
Field	ItemType	StartByte	Value	Ranges
BIN_X	Int2	181	43.000	[42.000; 43.000]
BIN_Y	Int2	185	1380.000	[1380.000; 1380.000]
CROSSLINE	Int4	193	5619.000	[5199.000; 6784.000]
FOLD	Int4	37	-3607.000	[-61619.000; -3607.000]
INLINE	Int4	189	2330.000	[2315.000; 2335.000]
RECEIVER_DEPTH	Int4	41	-69.000	[-72.000; -69.000]
RECEIVER_LINE	Int2	199	1.000	[1.000; 8.000]
RECEIVER_WDEPTH	Int4	65	1085.000	[990.000; 1724.000]
RECEIVER_X	Int4	81	2854657.000	[2785586.000; 2910864.000]
RECEIVER_Y	Int4	85	90502519.000	[90495812.000; 90505407.000]
SOURCE_DEPTH	Int4	49	60.000	[60.000; 60.000]
SOURCE_ID	Int2	197	1.000	[1.000; 2.000]
SOURCE_SP	Int4	17	1405.000	[1405.000; 1714.000]
SOURCE_WDEPTH	Int4	61	1157.000	[1152.000; 1918.000]
SOURCE_X	Int4	73	2853184.000	[2775992.000; 2853184.000]
SOURCE_Y	Int4	77	90499226.000	[90498659.000; 90499270.000]
SURVEY_ID	Int2	204	512.000	[512.000; 512.000]
TRACE_TYPE	Int2	201	1.000	[1.000; 1.000]

Binary Header

	Header value	Header new value	Bytes
Job identification number	9652	9652	1-4
Line number	2313	2313	5-8
Reel number	35002	35002	9-12
# data traces per record	478	478	13-14
# aux traces per record	0	0	15-16
Sample interval for reel	2000	2000	17-18
Sample interval for field	2000	2000	19-20
Number of samples for reel	4097	4097	21-22
Number of samples for field	4097	4097	23-24
Data sample format code	1	1	25-26
CDP fold	478	478	27-28
Trace sorting code	1	1	29-30
Vertical sum code	478	478	31-32
Sweep frequency at start	0	0	33-34
Sweep frequency at end	0	0	35-36
Sweep length	0	0	37-38
Sweep type code	0	0	39-40
Trace number of sweep channel	0	0	41-42
Sweep trace taper length at start	0	0	43-44
Sweep trace taper length at end	0	0	45-46

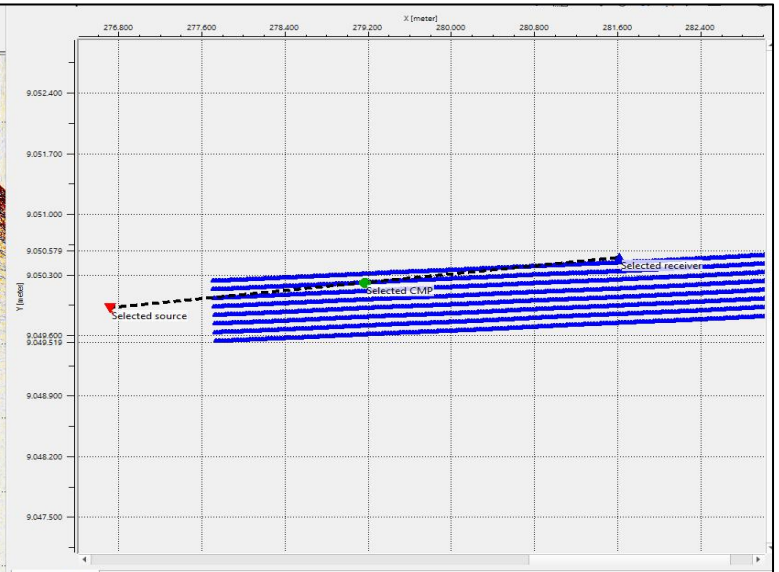
Geolander
Geologia, Geofísica e Engenharia

Seismic- Quality Control

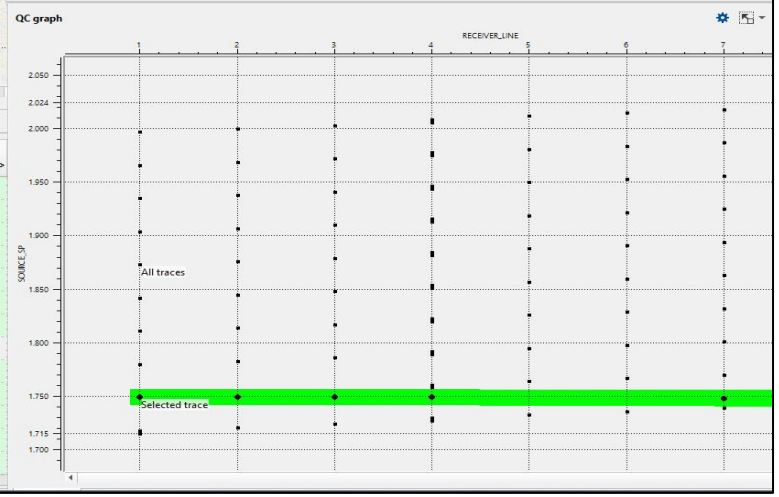


Seismic data

	fldr <FFID>	tracf <CHANNEL>	cp <SOURCE_SP> [Y]	cdp <CDP>	trid <TRACE_TYPE>	nhs <FOLD>	duse <DATA_USE>	offset <OFFSET>	gelev <RECEIVER_ELEV>	selev <SOURCE_ELEV>	sdepth <SOURCE_DEPTH>	gdel <RECEIVER_DATUM>	sdel <SOURCE_DATUM>	swdep <SOURCE_WDEPTH>	gwdep <RECEIVER_WDEPTH>	scalel <SCAL_ELEV>	scalco <SCAL_COORD>	sx <SOURCE_X>
130388	1749.0	372.0	1749.0	28004956.0	1.0	1.0	1.0	-48452.0	-70.0	-60.0	60.0	0.0	0.0	2085.0	1357.0	-10.0	-10.0	2767202.0
130389	1749.0	373.0	1749.0	28004954.0	1.0	1.0	1.0	-48576.0	-70.0	-60.0	60.0	0.0	0.0	2085.0	1357.0	-10.0	-10.0	2767202.0
130390	1749.0	374.0	1749.0	28004952.0	1.0	1.0	1.0	-48701.0	-70.0	-60.0	60.0	0.0	0.0	2085.0	1357.0	-10.0	-10.0	2767202.0
130391	1749.0	375.0	1749.0	28004952.0	1.0	1.0	1.0	-48826.0	-70.0	-60.0	60.0	0.0	0.0	2085.0	1353.0	-10.0	-10.0	2767202.0
130392	1749.0	376.0	1749.0	28004952.0	1.0	1.0	1.0	-48951.0	-70.0	-60.0	60.0	0.0	0.0	2085.0	1353.0	-10.0	-10.0	2767202.0
130393	1749.0	377.0	1749.0	28004950.0	1.0	1.0	1.0	-49076.0	-69.0	-60.0	60.0	0.0	0.0	2085.0	1353.0	-10.0	-10.0	2767202.0
130394	1749.0	378.0	1749.0	28004948.0	1.0	1.0	1.0	-49200.0	-69.0	-60.0	60.0	0.0	0.0	2085.0	1353.0	-10.0	-10.0	2767202.0
130395	1749.0	379.0	1749.0	28004948.0	1.0	1.0	1.0	-49325.0	-69.0	-60.0	60.0	0.0	0.0	2085.0	1349.0	-10.0	-10.0	2767202.0
130396	1749.0	380.0	1749.0	28004948.0	1.0	1.0	1.0	-49449.0	-69.0	-60.0	60.0	0.0	0.0	2085.0	1349.0	-10.0	-10.0	2767202.0
130397	1749.0	381.0	1749.0	28004946.0	1.0	1.0	1.0	-49572.0	-69.0	-60.0	60.0	0.0	0.0	2085.0	1349.0	-10.0	-10.0	2767202.0
130398	1749.0	382.0	1749.0	28004944.0	1.0	1.0	1.0	-49696.0	-69.0	-60.0	60.0	0.0	0.0	2085.0	1349.0	-10.0	-10.0	2767202.0
130399	1749.0	383.0	1749.0	28004944.0	1.0	1.0	1.0	-49820.0	-69.0	-60.0	60.0	0.0	0.0	2085.0	1342.0	-10.0	-10.0	2767202.0
130400	1749.0	384.0	1749.0	28004944.0	1.0	1.0	1.0	-49955.0	-69.0	-60.0	60.0	0.0	0.0	2085.0	1342.0	-10.0	-10.0	2767202.0

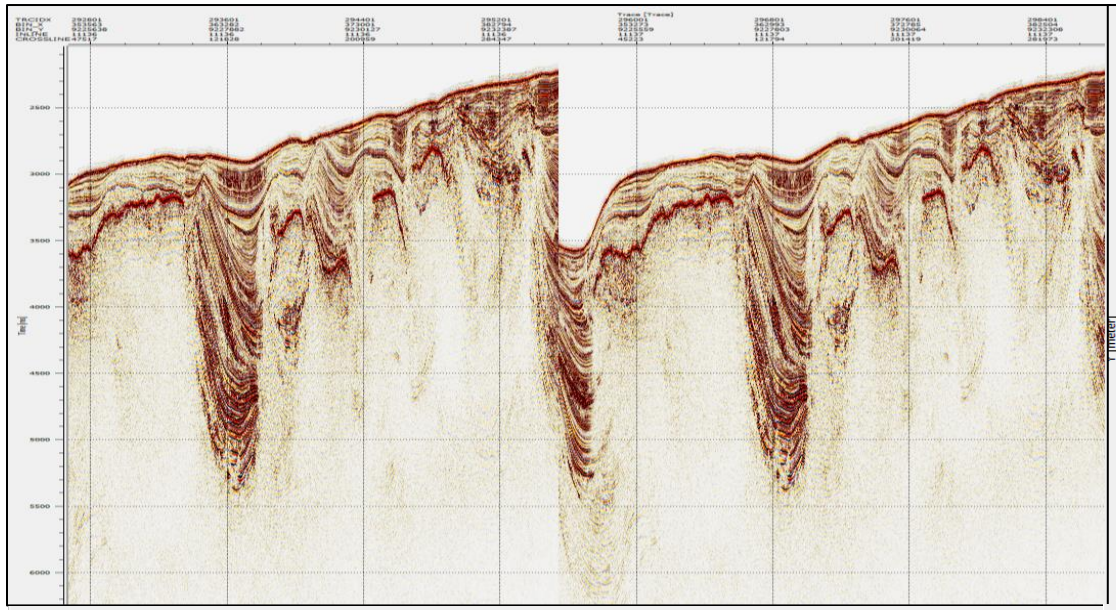


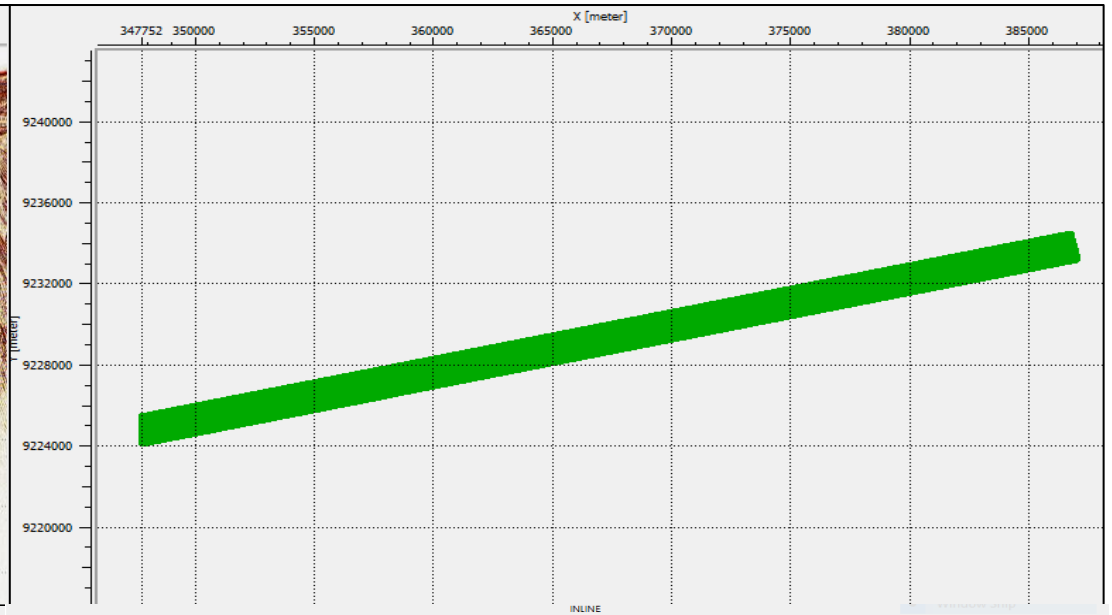
Location Map



Geolander
Geologia, Geofísica e Engenharia

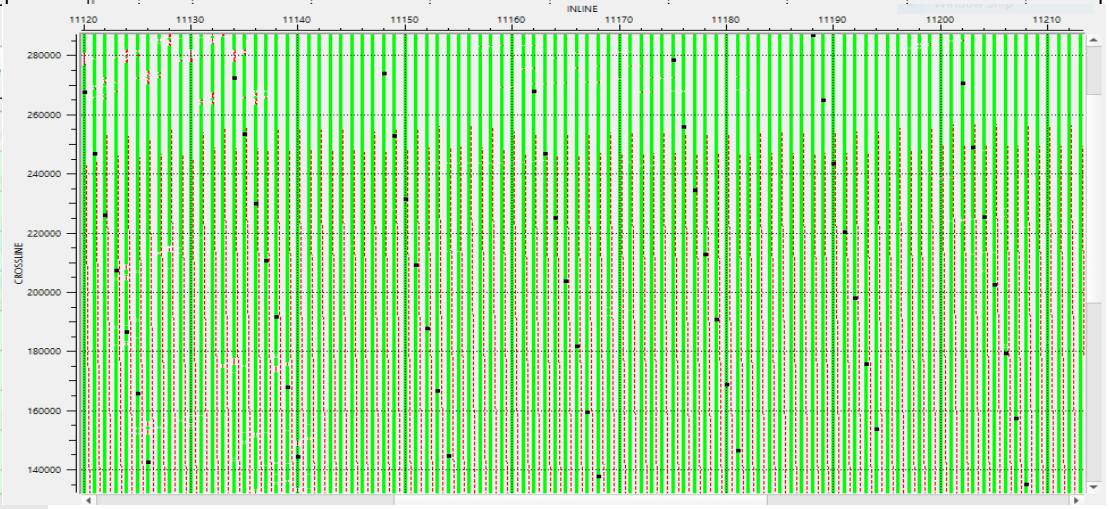
Seismic- Quality Control





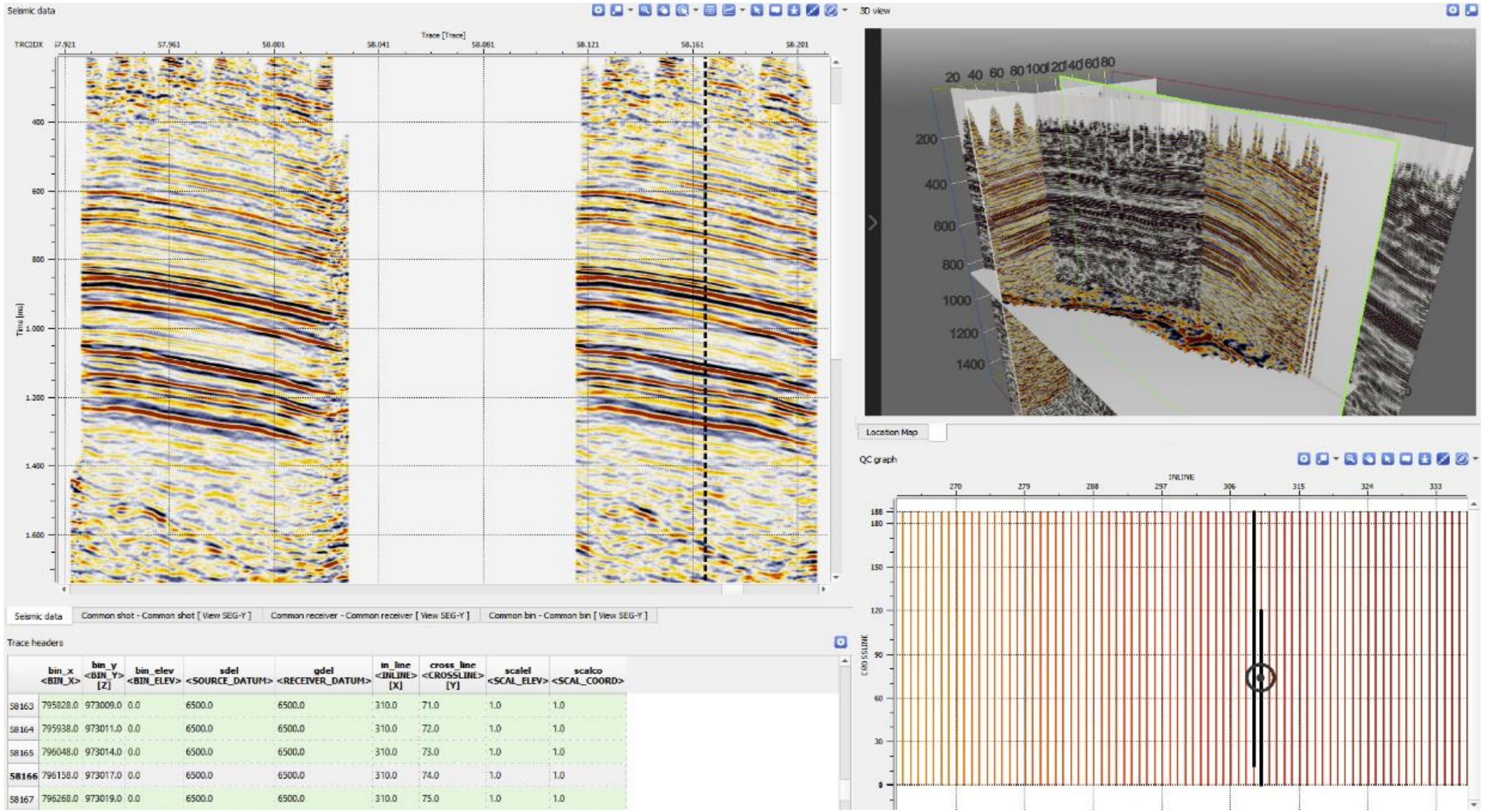
Trace headers

	dt <SAMPLE_INTERVAL>	trwf <TRACE_WEIGHT>	bin_x <BIN_X>	bin_y <BIN_Y>	in_line <INLINE> [X]	cross_line <CROSSLINE> [Y]	receiver_sp <RECEIVER_SP>	scalesp <SCAL_SP>	bin_elev <BIN_ELEV>	bin_sp <BIN_SP>	sline <SOURCE_LINE>	gline <RECEIVER_
1	3000.0	4418.0	0.0	6553600.0	11045.0	2289.0	0.0	0.0	524288.0	0.0	0.0	0.0
2	3000.0	4418.0	0.0	6553600.0	11045.0	1889.0	0.0	0.0	524288.0	0.0	0.0	0.0
3	3000.0	4418.0	0.0	6553600.0	11045.0	2289.0	0.0	0.0	524288.0	0.0	0.0	0.0
4	3000.0	4418.0	0.0	6553600.0	11045.0	1889.0	0.0	0.0	524288.0	0.0	0.0	0.0
5	3000.0	4424.0	0.0	6553600.0	11045.0	2289.0	0.0	0.0	524288.0	0.0	0.0	0.0
6	3000.0	4427.0	0.0	6553600.0	11045.0	1889.0	0.0	0.0	524288.0	0.0	0.0	0.0
7	3000.0	4427.0	0.0	6553600.0	11045.0	2289.0	0.0	0.0	524288.0	0.0	0.0	0.0
8	3000.0	4427.0	0.0	6553600.0	11045.0	1889.0	0.0	0.0	524288.0	0.0	0.0	0.0
9	3000.0	4427.0	0.0	6553600.0	11045.0	2289.0	0.0	0.0	524288.0	0.0	0.0	0.0
10	3000.0	4427.0	0.0	6553600.0	11045.0	1889.0	0.0	0.0	524288.0	0.0	0.0	0.0



Geolander
Geologia, Geofísica e Engenharia

Seismic- Quality Control



	bin_x <BIN_X>	bin_y <BIN_Y> [Z]	bin_elev <BIN_ELEV>	sdel <SOURCE_DATUM>	gdel <RECEIVER_DATUM>	in_line <INLINE> [X]	cross_line <CROSSLINE> [Y]	scalel <SCAL_ELEV>	scalco <SCAL_COORD>
58163	795828.0	973009.0	0.0	6500.0	6500.0	310.0	71.0	1.0	1.0
58164	795938.0	973011.0	0.0	6500.0	6500.0	310.0	72.0	1.0	1.0
58165	796048.0	973014.0	0.0	6500.0	6500.0	310.0	73.0	1.0	1.0
58166	796158.0	973017.0	0.0	6500.0	6500.0	310.0	74.0	1.0	1.0
58167	796268.0	973019.0	0.0	6500.0	6500.0	310.0	75.0	1.0	1.0

Conclusion

- Transcription and reformat will result in standardization of storage media and data formats across a company's seismic data library. This will ensure consistency and efficiency of data loading for future analysis.

- Redundant data are converted into live assets with a tangible value and are readily accessible for analysis with the latest data processing technology.

- Effective management of storage spaces.

- Data security and protection.

- Ease in creating new study projects.

- Ease for data export.

- Not data duplication.

- Reference documents.

Questions