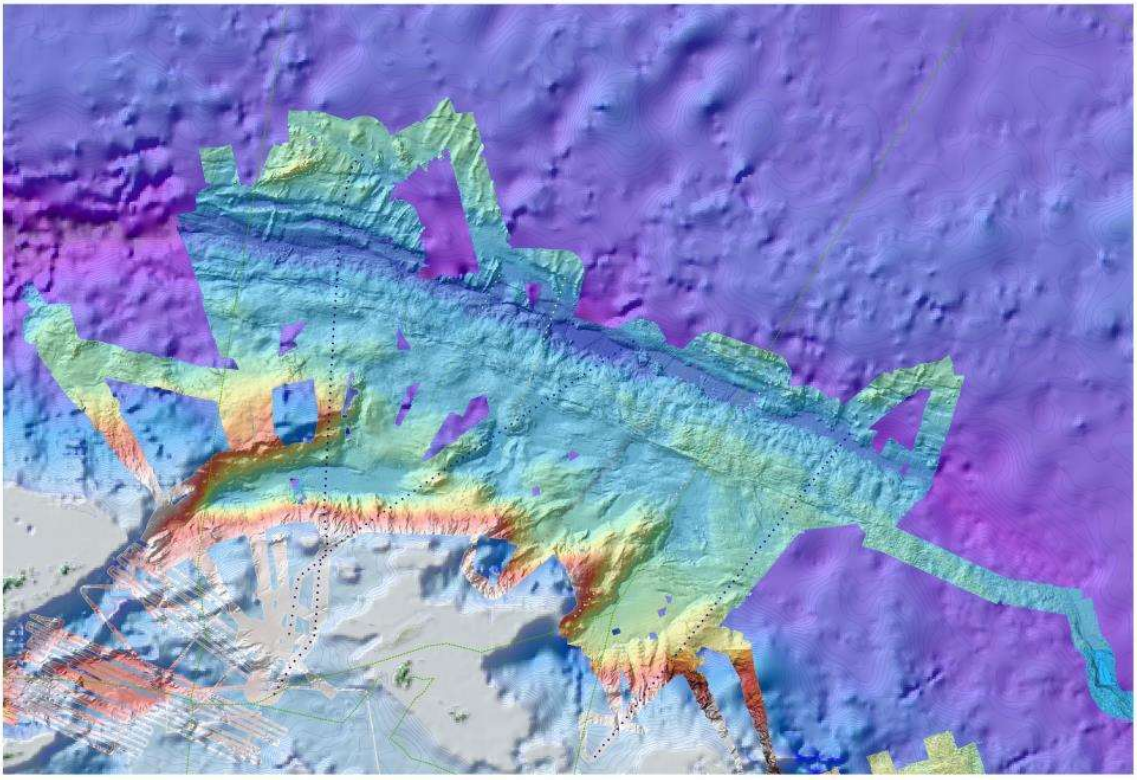
Antithesis Cruise

23/11/2015 – 08/01/2014

Oceanographic Vessel Atalante

(p.i. : Boris Marcaillou and Frauke Klingelhoefer)



Preliminary results

and

Data collected within the British territorial waters

Data acquired within the British territorial waters
in Northern Lesser Antilles during the Antithesis Cruise

Introduction

The "Antithesis" (Antilles Thermicity Sismogenesis) cruise was dedicated to geophysical data acquisition along the Northern Lesser Antilles subduction zone, from the 24 November 2013 to the 08 January onboard French Oceanographic Vessel "Atalante". This campaign and the current data interpretation aim at deciphering the tectono-structural pattern and the seismogenic hazard of the subduction zone that extend from Montserrat to Virgin Islands.

Persons in charge

The person in charge of the project at the onshore GENAVIR administration is :

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The Scientist in charge onboard was :

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Scientific objectives

This project presents a study of the seismogenic potential of the Antilles subduction zone. The acquisition of deep reflection and wide-angle seismic data together with heat flow measurements, and bathymetry data will help at answering scientific questions about the geometry and characteristics of the subduction channel and the deep structure of the margin. The project also aims at recording the seismic activity and the whales sounds using the hydrophones included in the bottom sismometers.

What is the overall geometry of this subduction zone and the dip of the subducted slab? This geometry at least partly controls the strain transfer from the underthrusting plate to the overriding plate and thus the tectonic deformation and the interplate coupling within the subduction zone.

What is the impact of the subduction of ridges on the seismogenic and tectonic behaviour of the margin? The high buoyancy of ridges is thought to increase the seismic coupling, alternatively triggering interplate earthquakes or behaving as seismic barrier to rupture propagation.

What are the thermal and mechanical characteristics of the intraplate contact? Subduction earthquakes occur within a temperature range; estimating temperature distribution along the interplate allows estimating the location of the seismogenic zone.

Which margin segment and faults are seismically active in the Northern Lesser Antilles

The Vessel

Name: Atalante
Nationality: French
Owner: Ifremer
Operator: Genavir
Load displacement: 3 550 t
Overall length: 84,60 m
Maximum draught: 5,1 m
Gross tonnage: 3 559 UMS
Propulsion: Diesel electric
Average operating cruising speed and survey speed: 11 knots
Call sign: FNCM
Method and capability of communication (including telex, frequencies) :
GSM:33.6.82.81.38.16 (bridge) - 06.82.81.37.89 (captain) -
Fax: 33.6.29.36.97.41
Inmarsat: Tel : 00.870.773.160.305 or 00.870.3.227.222.52 (std. auto)
Fax: 00.870.783.180.644 (bridge) or 00.870.3.227.222.60
Vsat: Tel : 33.2.29.00.85.70
Fax: 33.2.29.00.85.71
Telex: Inmarsat C1 : 058x.4.227.222.14 - Inmarsat C2 : 058x.3.227.222.15
(Atlantic East : 0581 ; Atlantic West : 0584 ; Pacific : 0582 ; Indian ocean : 0583)
Email: AT.Commandant@atalante.ifremer.fr
Email Telex C1: AtalanteC1@skyfile-c.com
Email Telex C2: AtalanteC2@skyfile-c.com
Number of crew: 30
Number of scientists on board: 30

Data acquired in UK waters

- *Vessel route*

A significant part of acquired data is located in UK waters. Figure 1 shows the vessel route during the cruise and Table 1 indicates the periods during which the vessel was in the UK waters.

Day	Hour	Entry/exit in UK waters
26/11/2013	9h30	Entry
07/12/2013	9h30	Exit to Antigua-Barbuda
08/12/2013	4h00	Entry
13/12/2013	10h15	Exit to Antigua-Barbuda
17/12/2013	20h20	AB to UK
19/12/2013	22h15	Exit to Antigua-Barbuda
20/12/2013	04h30	AB to UK
20/12/2013	17h45	Exit to Antigua-Barbuda
21/12/2013	07h45	AB to UK
21/12/2013	17h45	Exit to Antigua-Barbuda
21/12/2013	21h15	AB to UK
22/12/2013	09h00	Exit to Antigua-Barbuda

Table 1 : Days and hours for entries into and exit from UK waters. Route detail is shown in Figure 1

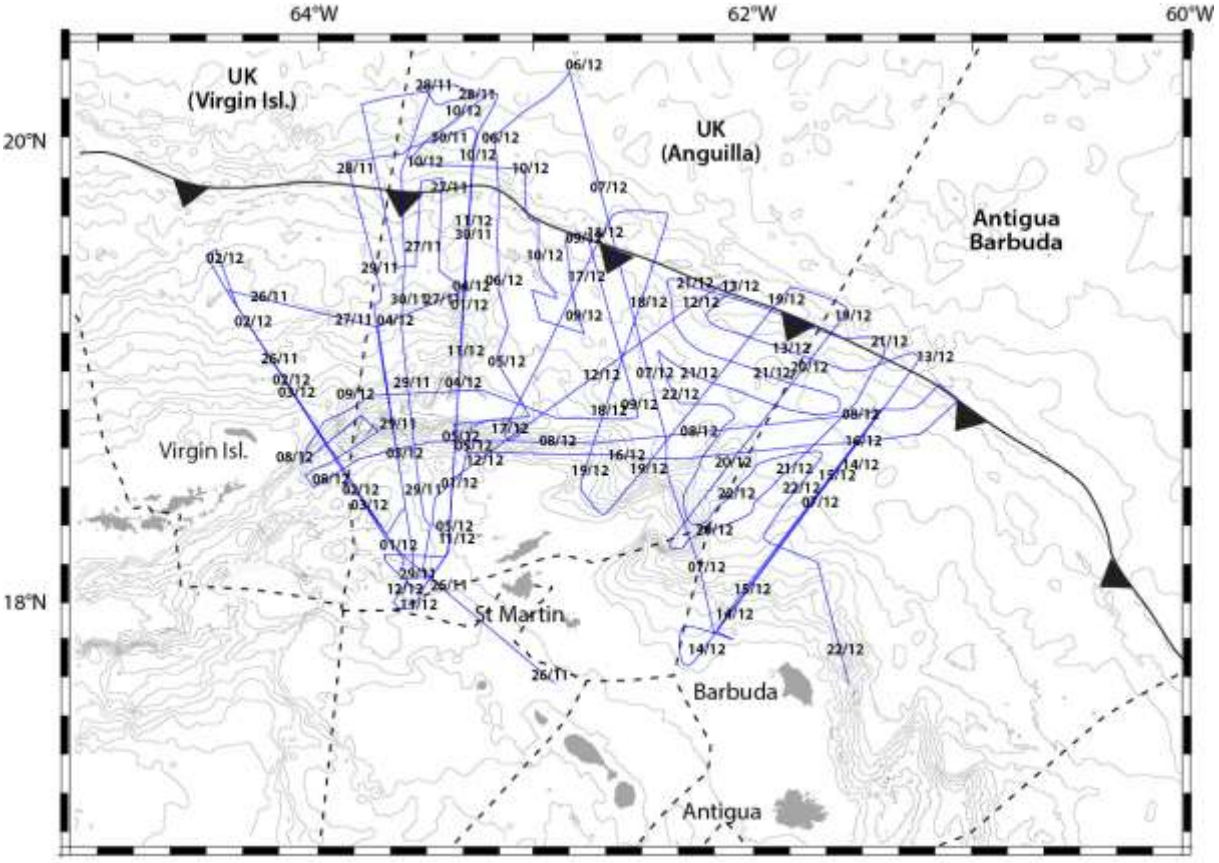


Figure 1 : the vessel route within UK waters during the Antithesis cruise. Precise days and hours of entry/exit in UK waters are indicated in Table 1. Dashed lines represents the limits of UK, Antigua-Barbuda, French and Dutch waters.

- *Multi-channel seismic lines (data in Annex 1)*

We acquired 9 lines using a 4.5 km seismic streamer and an airgun array of about 6300 cu. Inch. The lines are labelled Ant-01, Ant-07, Ant-08, Ant-09, Ant-10.1 and 10.2, Ant-11.1 and 11.2, Ant-12, Ant-13 and Ant-14 (Figure 2). The easternmost extent of the three latter lines were acquired in Antigua-Barbuda waters.

The corresponding data are sorted in directory MCS/line_label that include .segd files. Each segd file include every data corresponding with a shot point.

- *Seismic refraction lines (data in Annex 2)*

We acquired 3 refraction lines in UK waters using Ocean Bottom Seismometers (OBS) labelled Ant-01 (14 OBSs), Ant-03 (10 OBSs) and Ant-05 (16 OBSs). The OBSs location is shown in Figure 2. Corresponding data is provided in directory OBS/line-Label/OBS_number/. Every OBS directory includes 4 segy files corresponding with the 3 oriented geophone channels and the hydrophone channel. In line Ant-01, OBS-06 recorded no data. In line Ant-03, OBS-04 and OBS -06 recorded no data either.

- *Bathymetry (data in Annex 3)*

We acquired bathymetry data during the entire cruise along the vessel route (Figure 1) using a Multibeam bathymetric echosounder EM122. The data are divided in .all files located in directory as described in Table 2.

Directory (yr_mth_day)	Nb of files	Directory (yr_mth_day)	Nb of files
20131126_090209-20131207_095518	218	20131220_042823-20131220_181121	15
20131208_035923-20131213_103634	142	20131221_065705-20131221_181752	14
20131217_195849-20131219_221445	54	20131221_205618-20131222_095017	16

Table 2 : Bathymetry data list distributed in .all files in corresponding directory

- *Very high resolution seismic data (3.5 KHz SUBOP).*

We acquired very high resolution data during the entire cruise along the vessel route (Figure 1) using a 2.5 KHz Subop. The data are divided in .SEG files located in directory as described in Table 2.

Directory (yr_mth_day)	Nb of files	Directory (yr_mth_day)	Nb of files
20131126_090256-20131207_093357	91	20131220_050514-20131220_175110	17
20131208_043417-20131213_111153	101	20131221_073800-20131221_172930	10
20131217_201052-20131219_221943	51	20131221_220304-20131222_094246	14

Table 3 : very high resolution seismic data list in .SEG files in corresponding directory

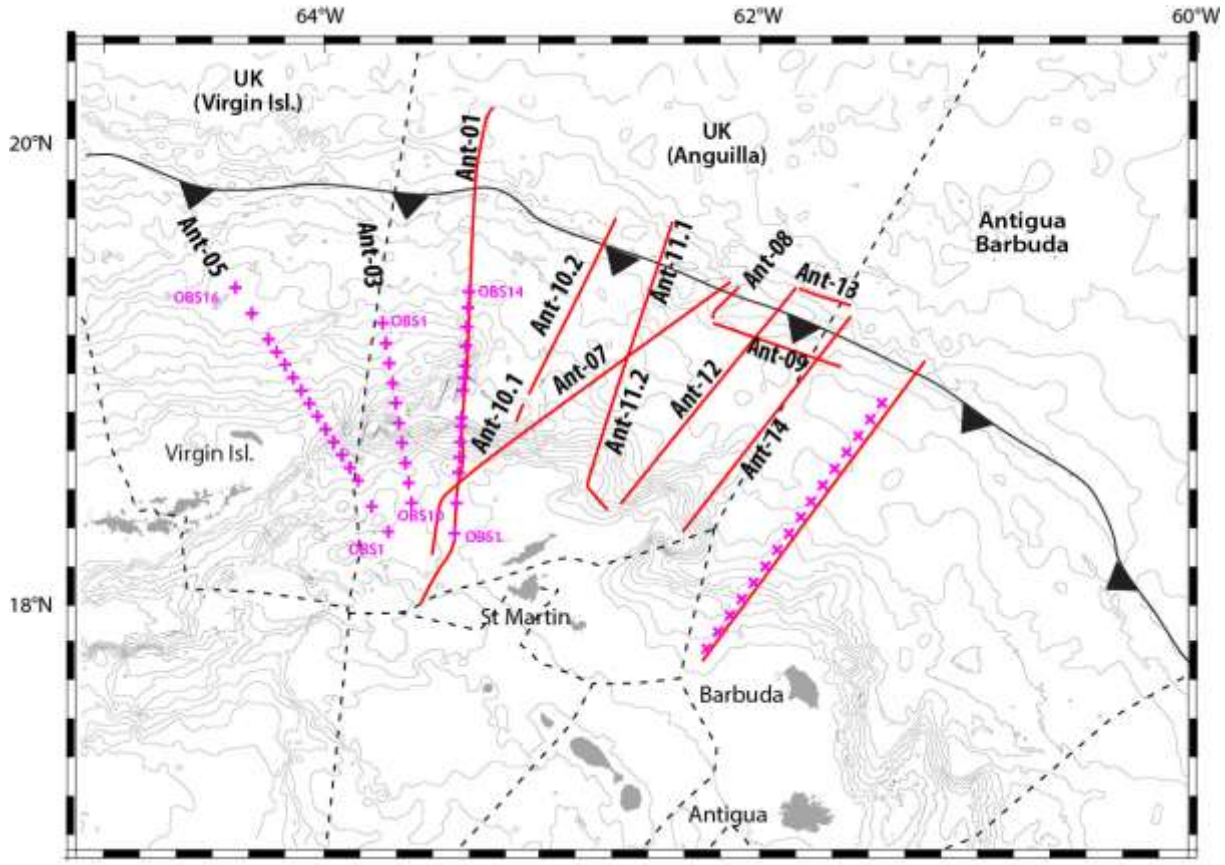
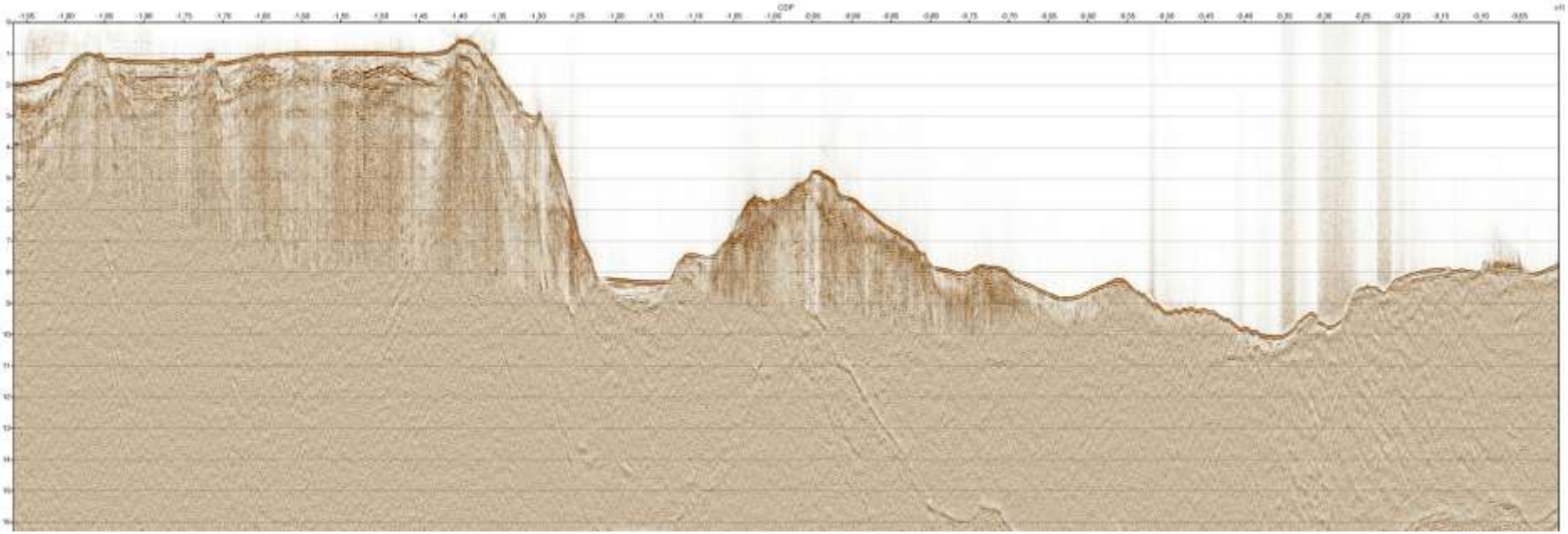
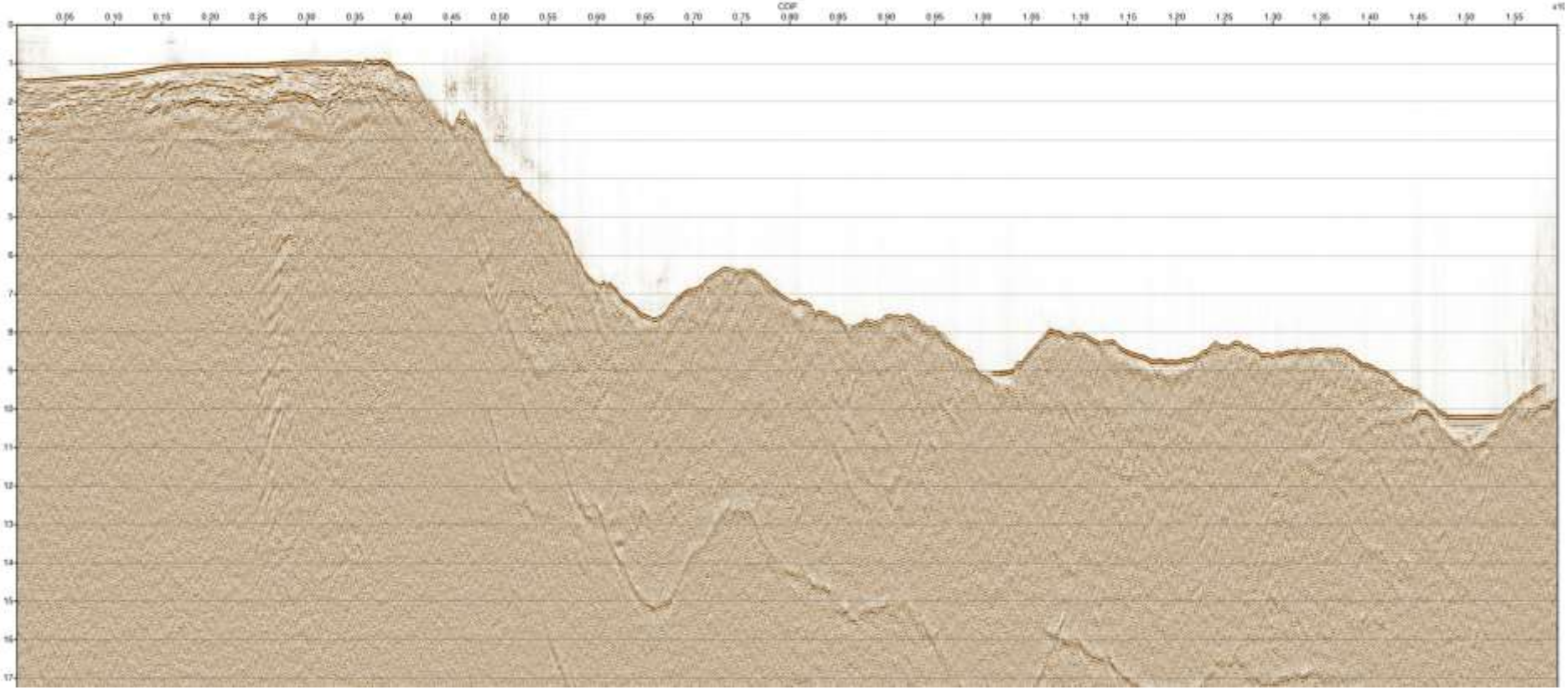


Figure 2 : Location of multichannel reflexion seismic lines (red lines) and refraction lines with Ocean

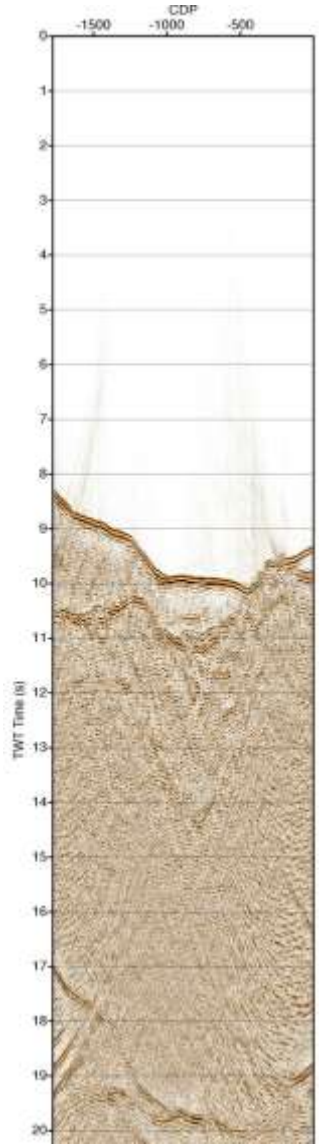
Annex 1: MCS lines



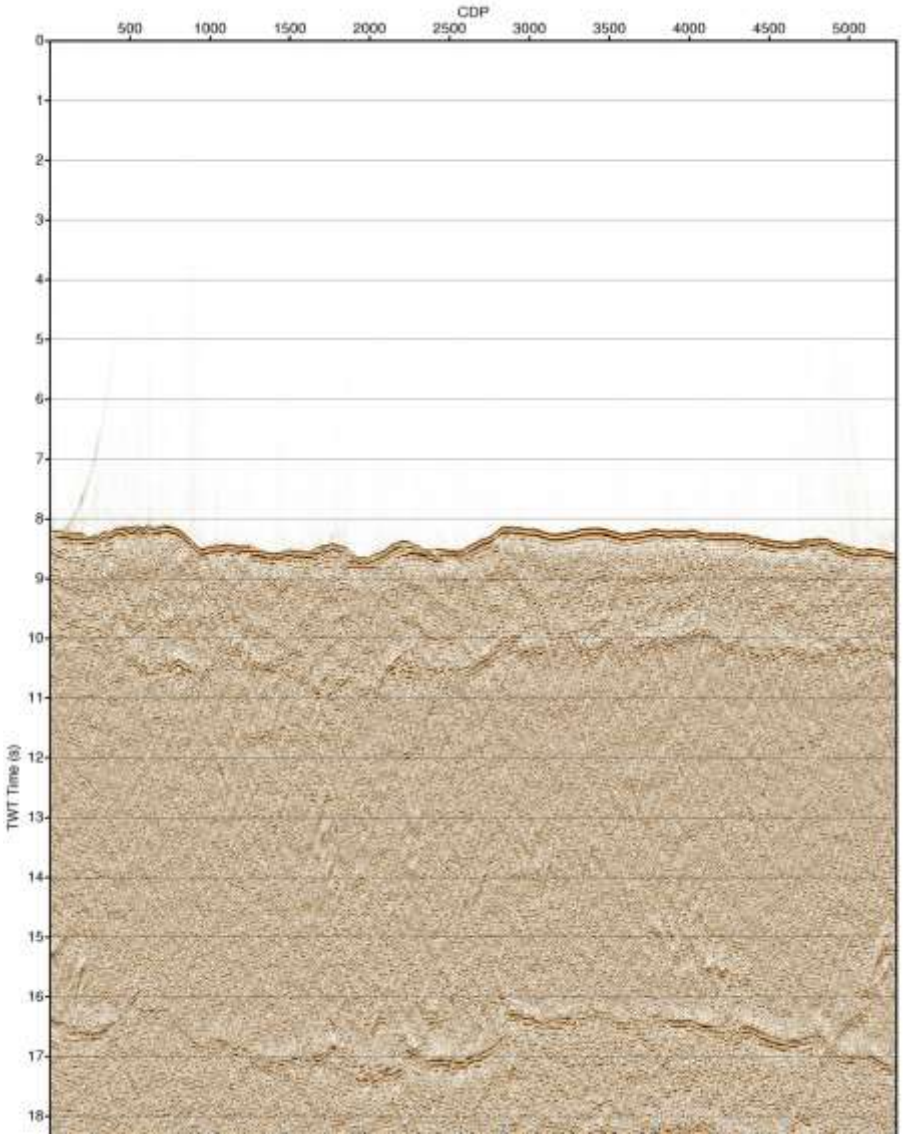
MCS line Ant-01



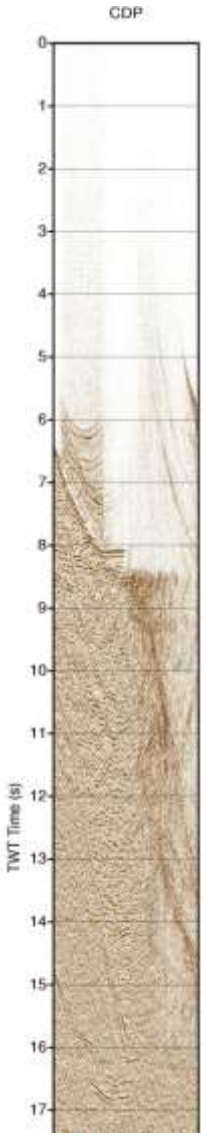
MCS Line Ant-07



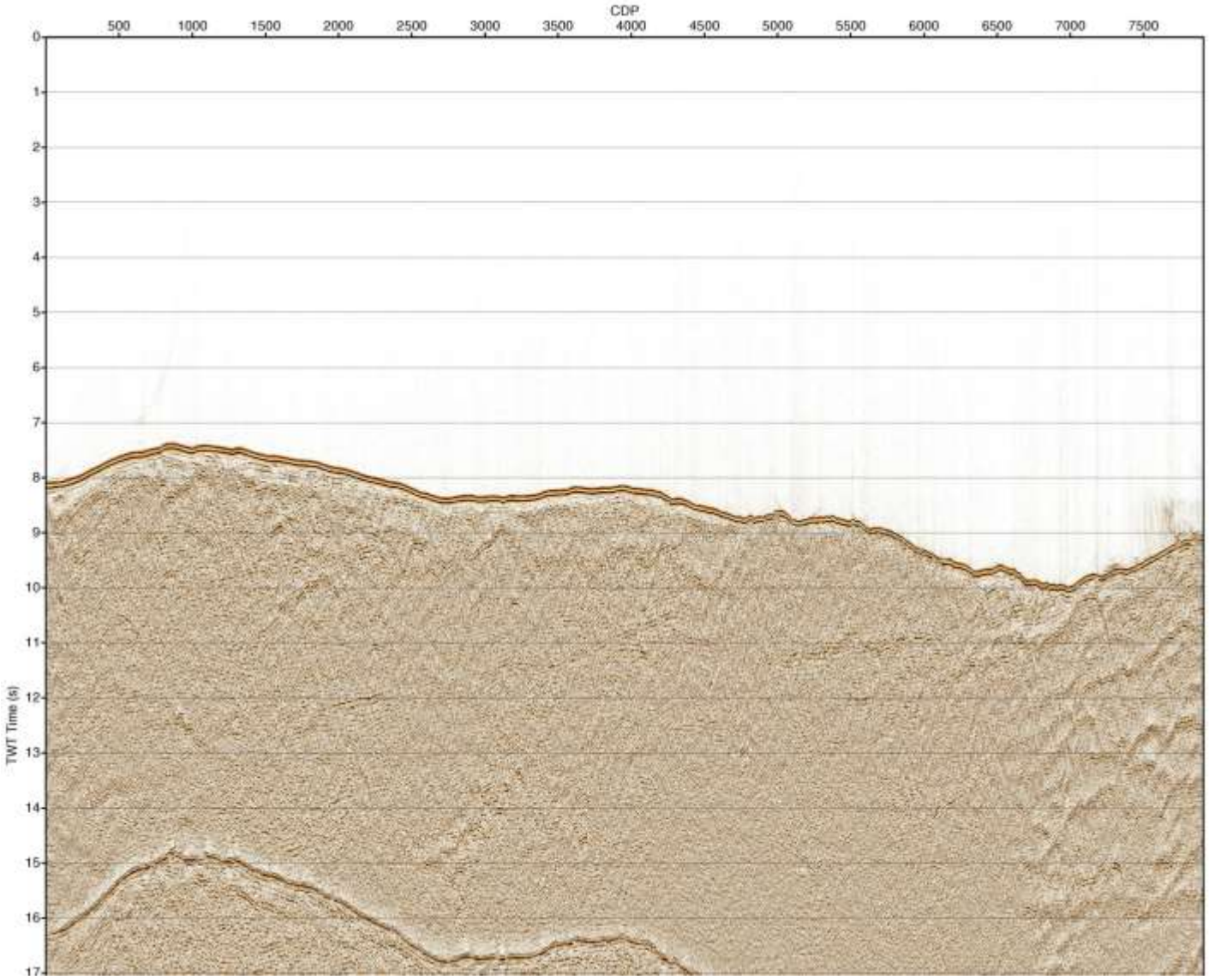
MCS line Ant-08



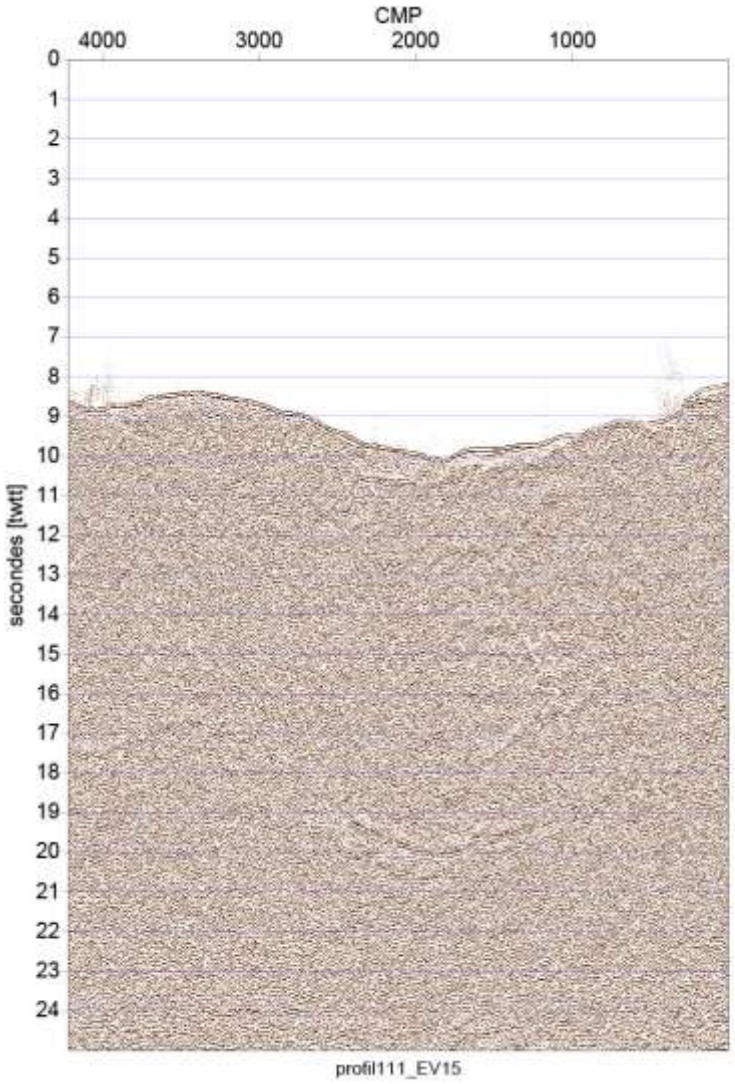
MCS line Ant-09



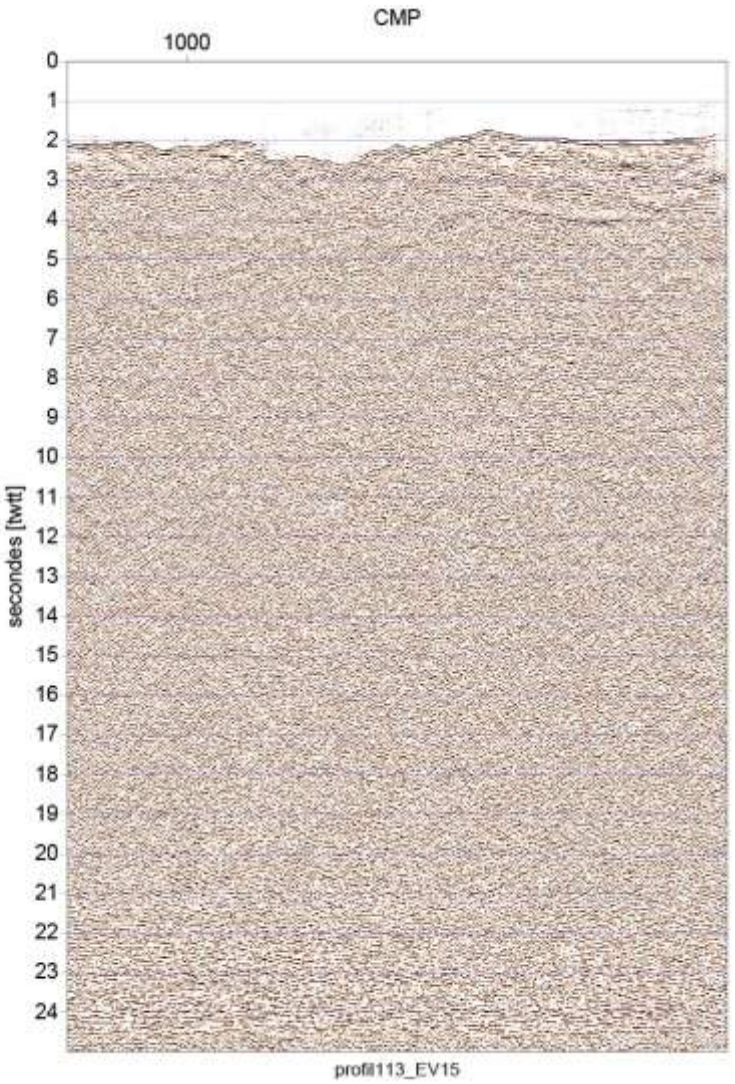
MCS line 10.1



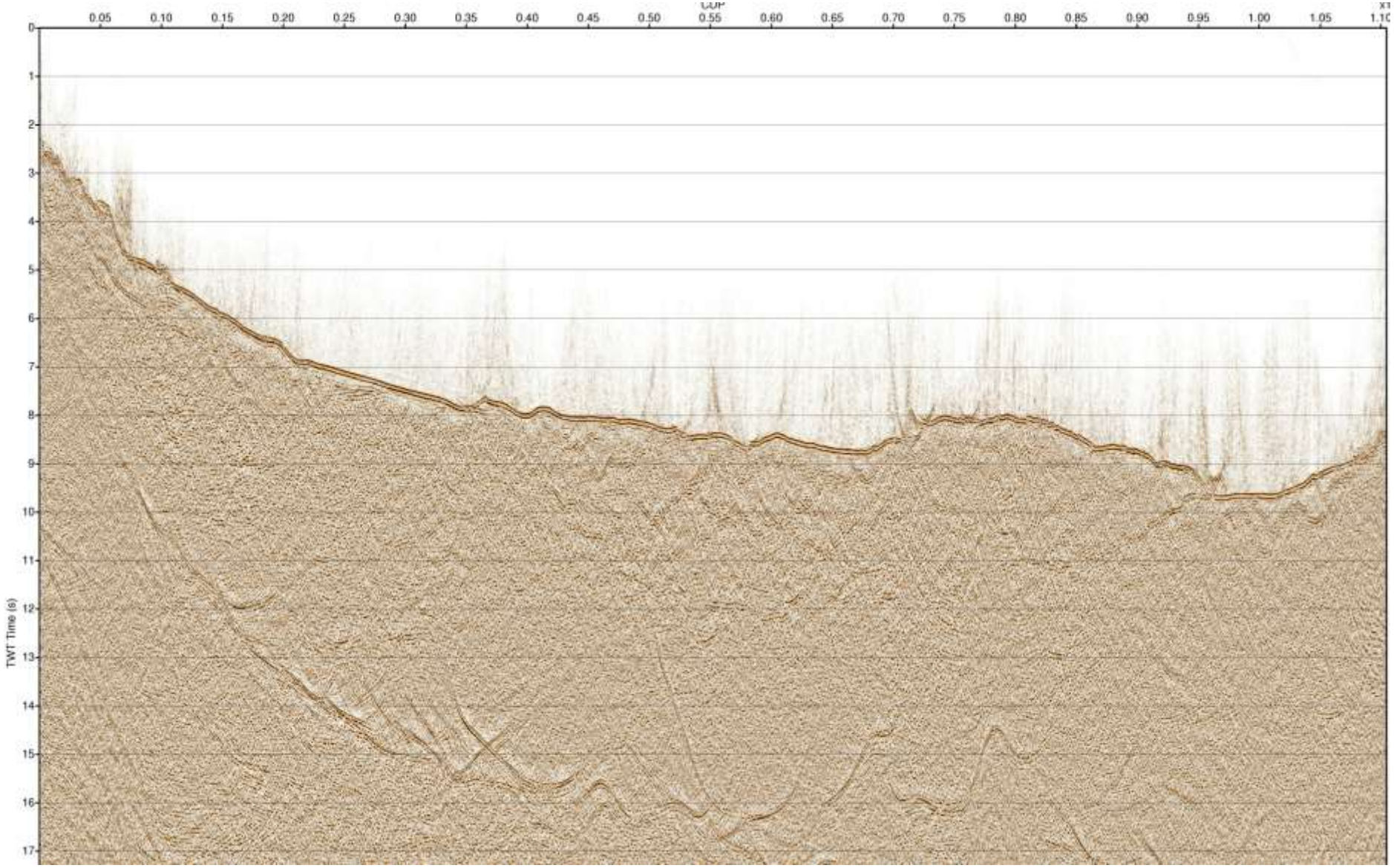
MCS line Ant10.2



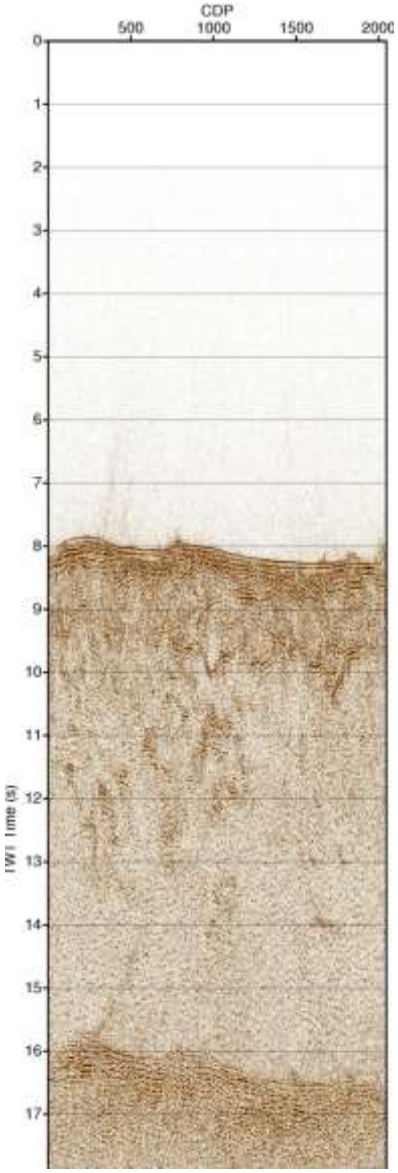
MCS line Ant-10.1



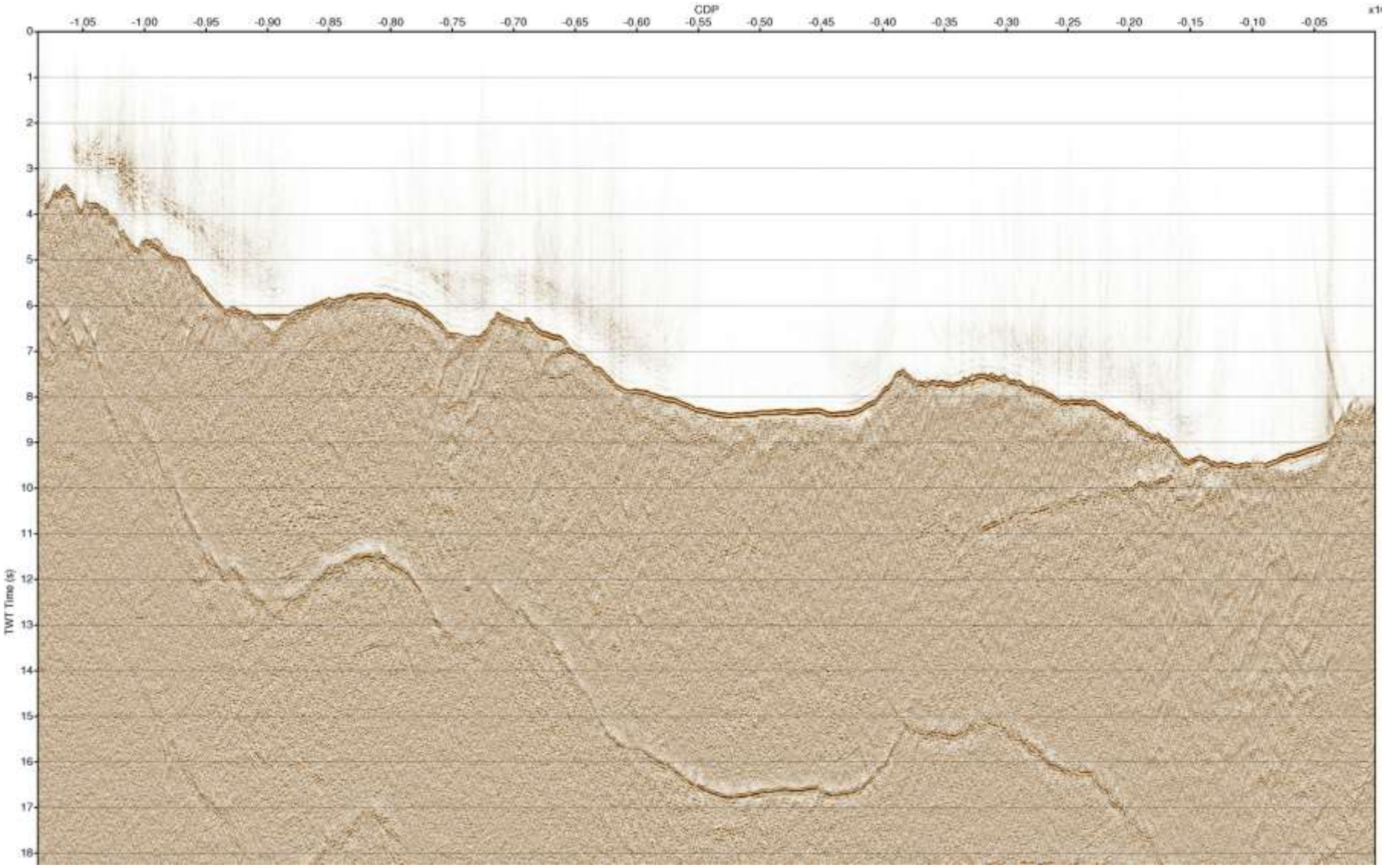
MCS line Ant-10.3



MCS line Ant-12

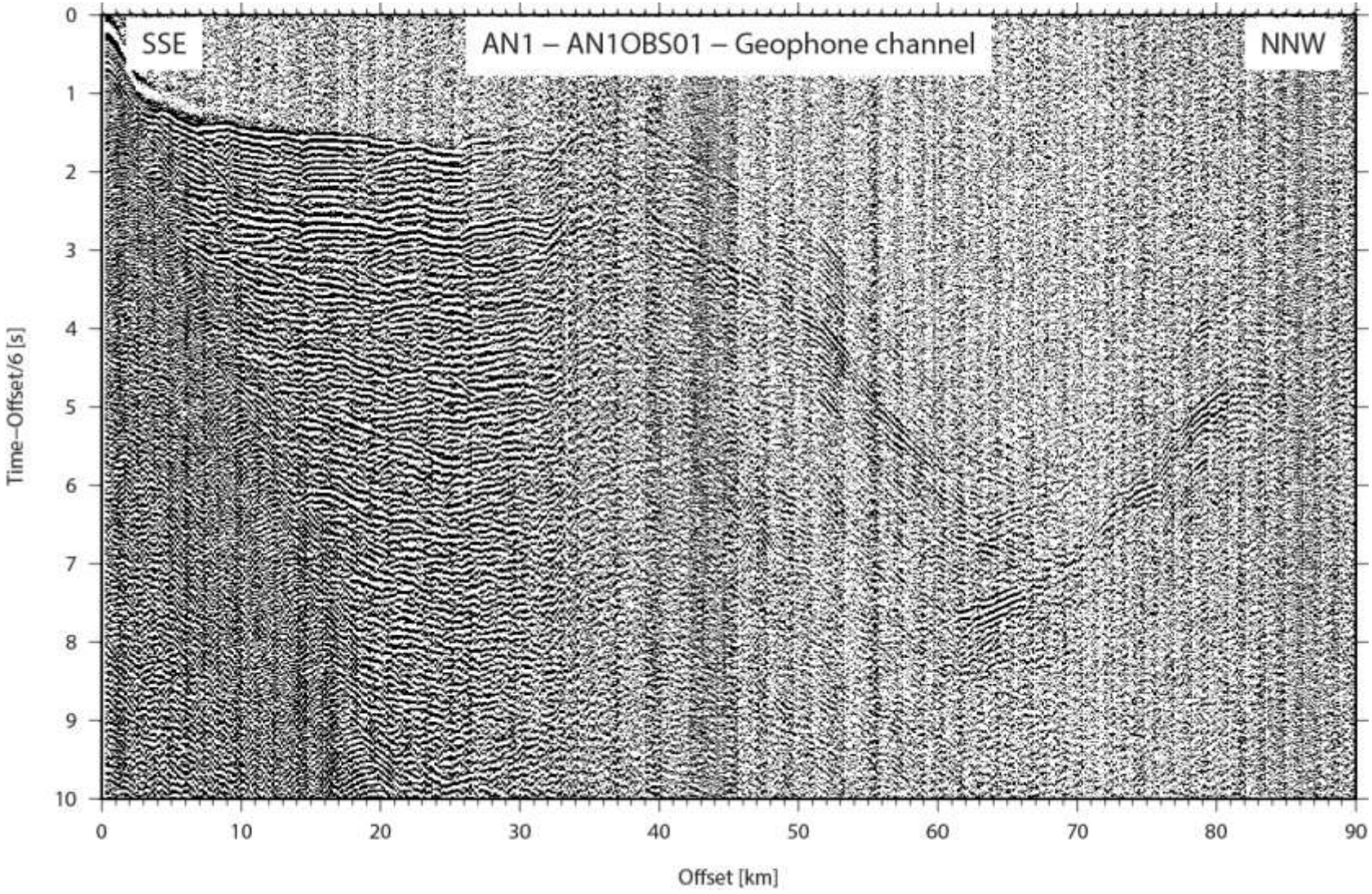


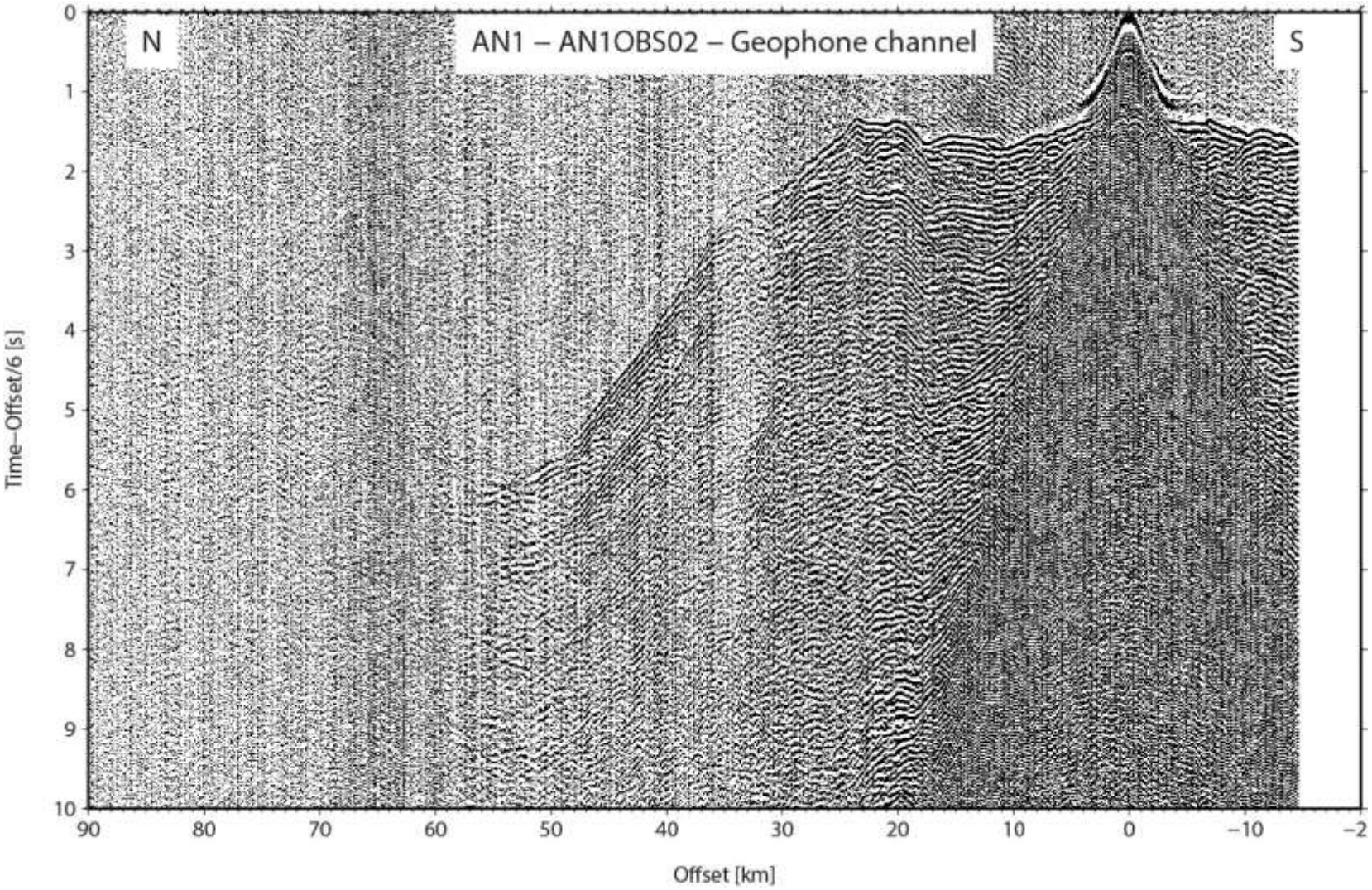
MCS line Ant-13



MCS line Ant-14

Annex 2: OBS geophone data




N
AN1 – AN1OBS02 – Geophone channel
S
Time–Offset/6 [s]
0
1
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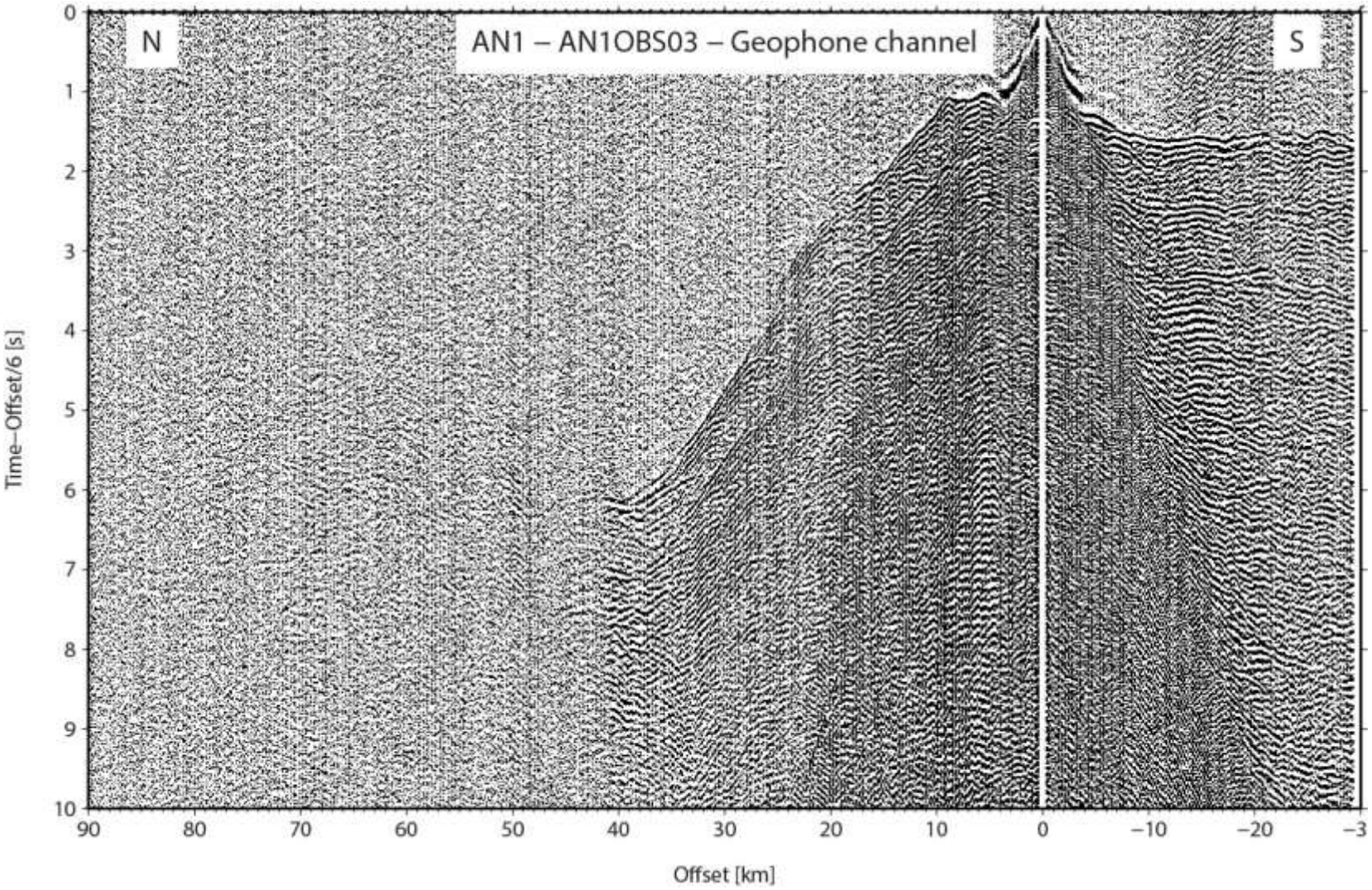
9
10
90
80
70
60
50
40
30
20
10
0
−10
−2
Offset [km]


N
AN1 – AN1OBS03 – Geophone channel
S
Time–Offset/6 [s]
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40
30
20
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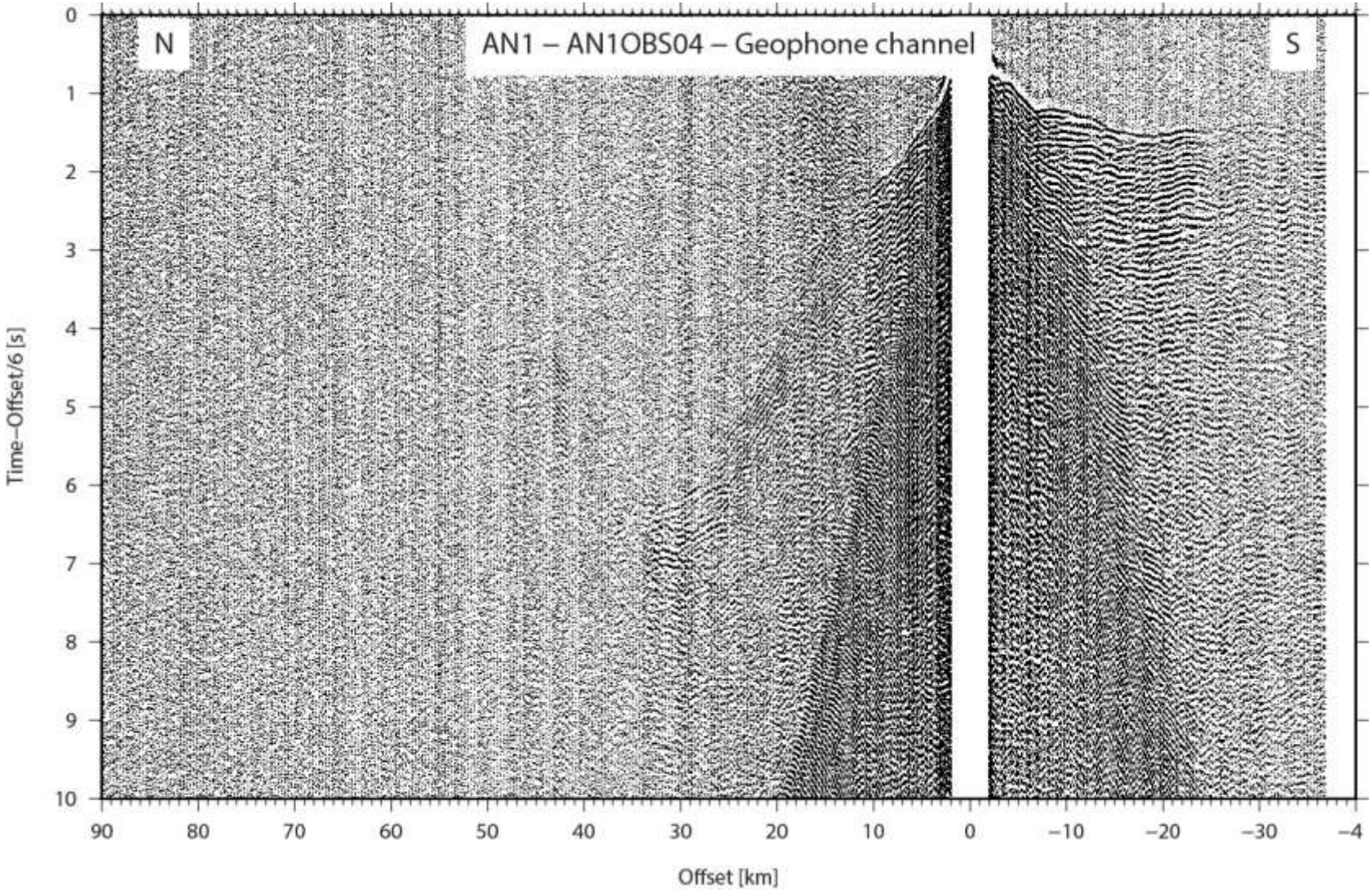
0
−10
−20
−3
Offset [km]


N
AN1 – AN1OBS04 – Geophone channel
S
Time–Offset/6 [s]
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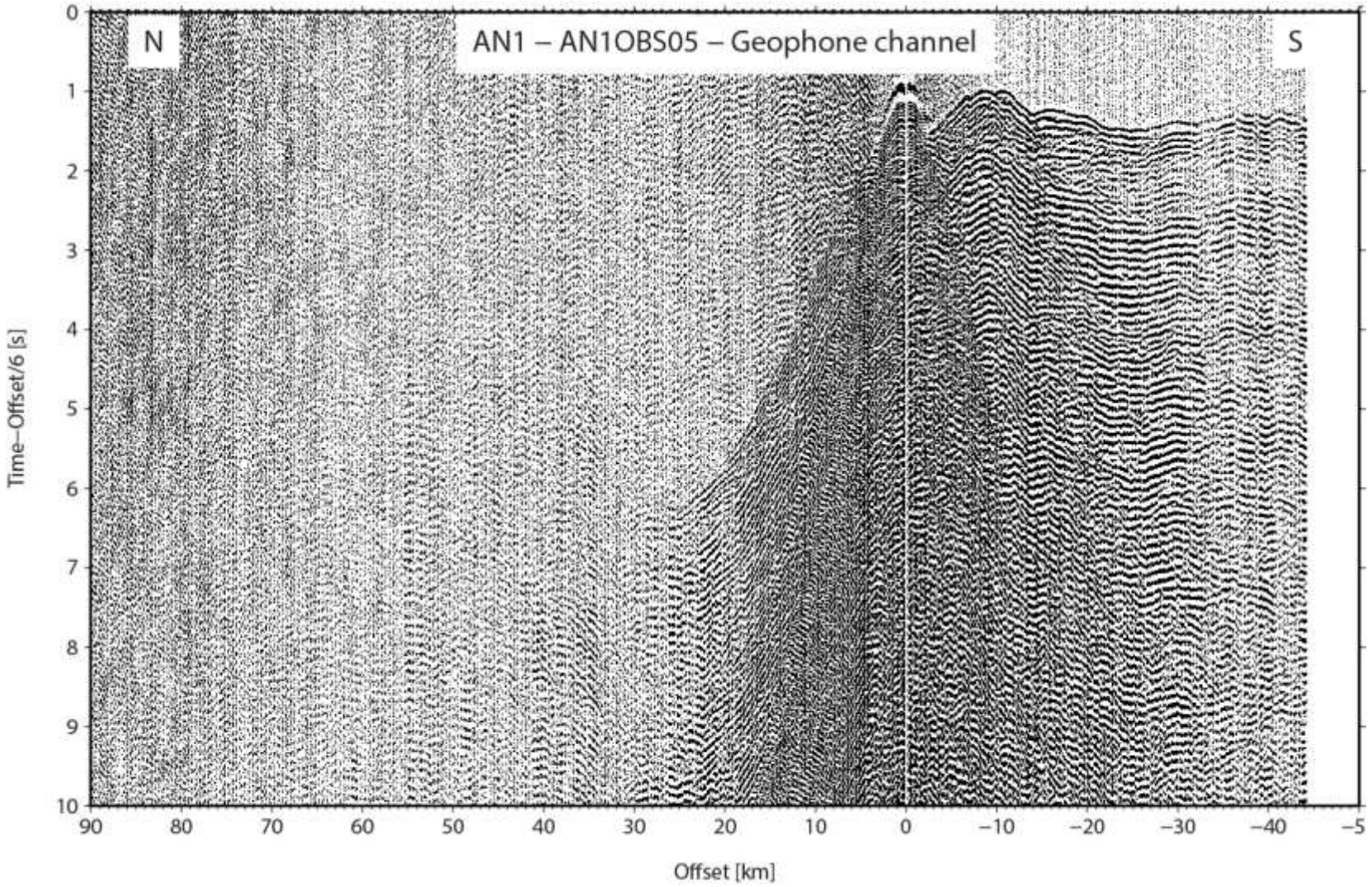
−30
−4
Offset [km]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AN1 – AN1OBS05 – Geophone channel
S
Time–Offset/6 [s]
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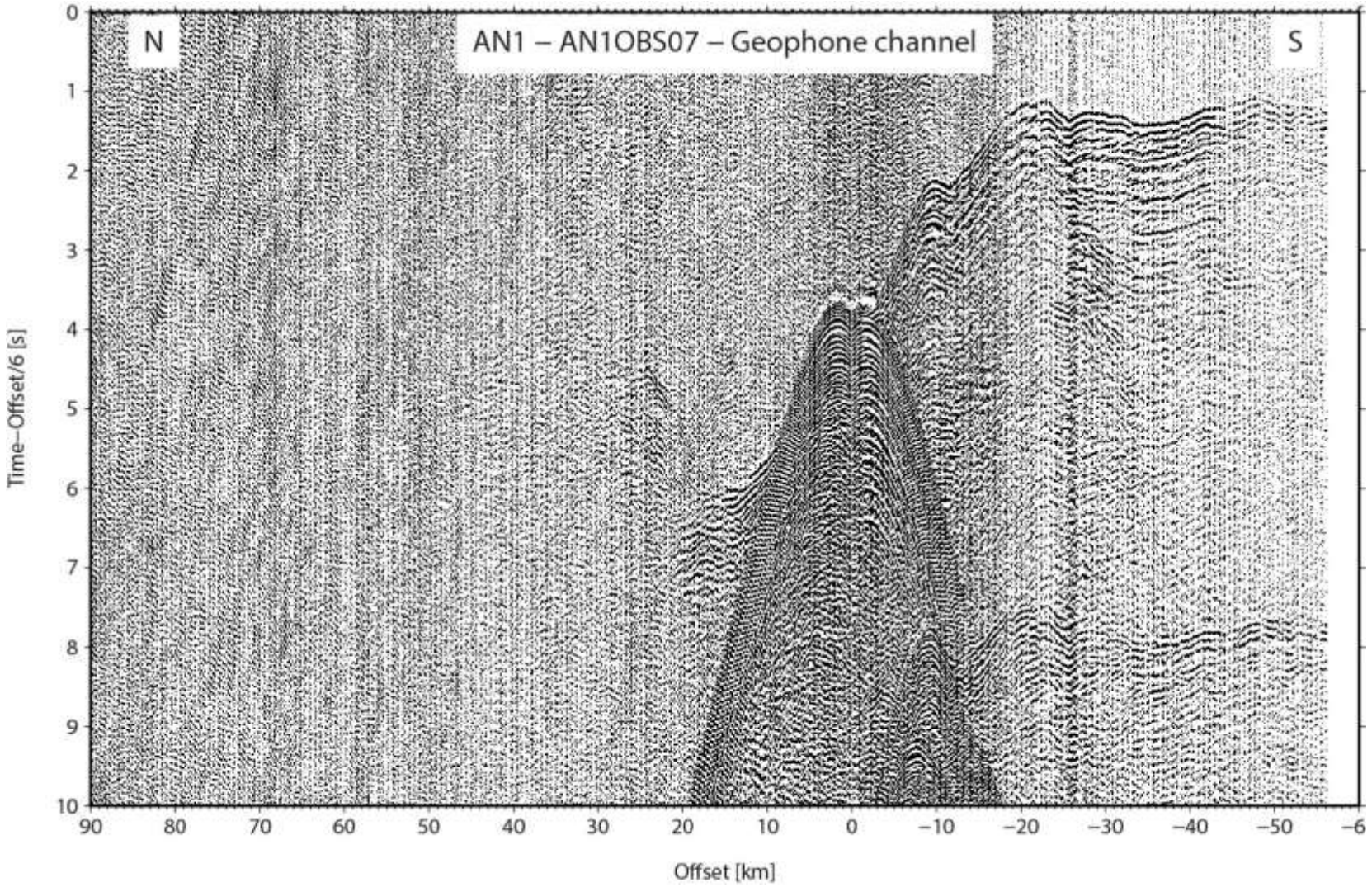
−20
−30
−40
−5
Offset [km]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AN1 – AN1OBS07 – Geophone channel
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Time–Offset/6 [s]
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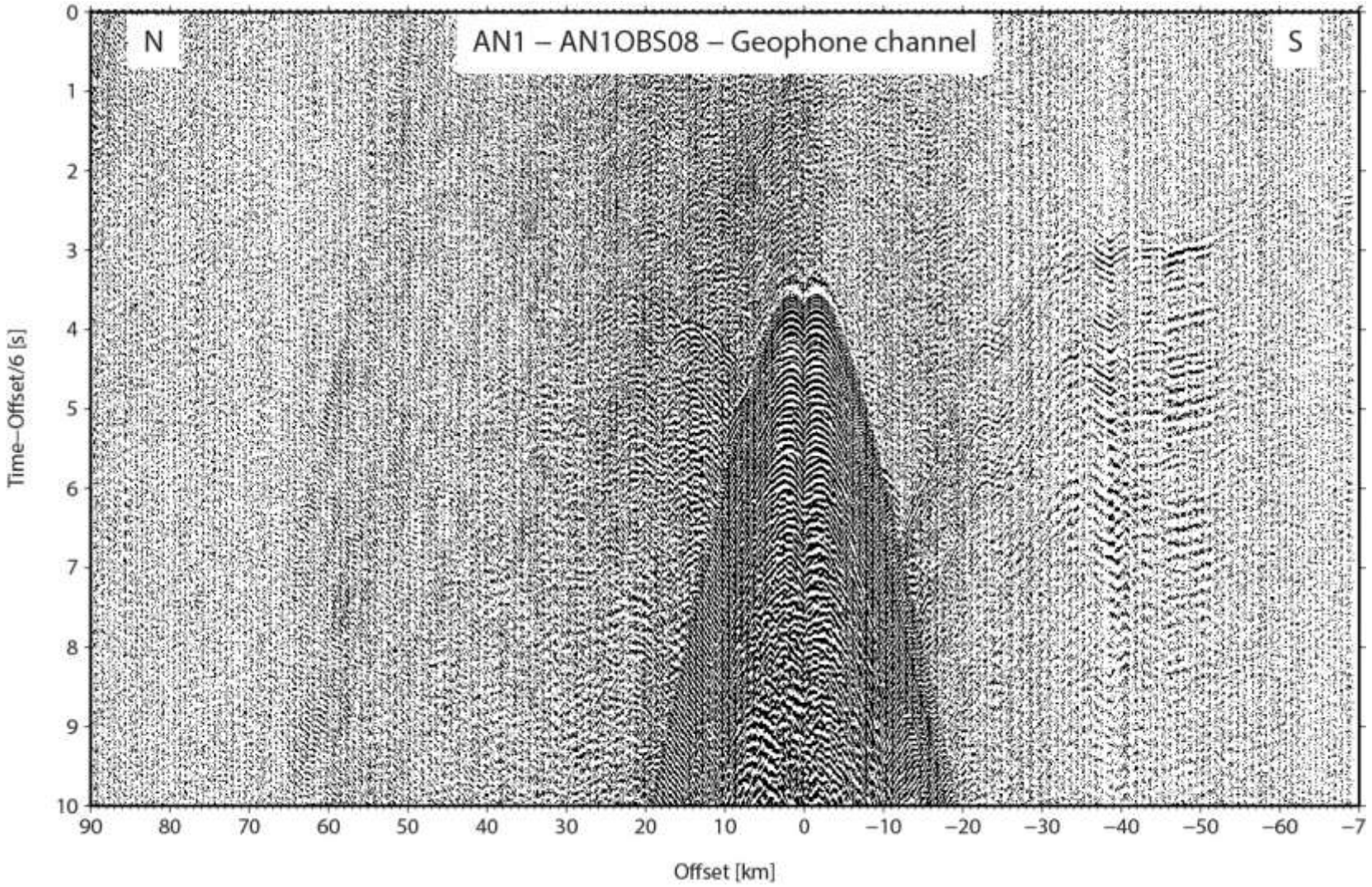
−50
−6
Offset [km]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AN1 – AN1OBS08 – Geophone channel
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Time–Offset/6 [s]
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−20
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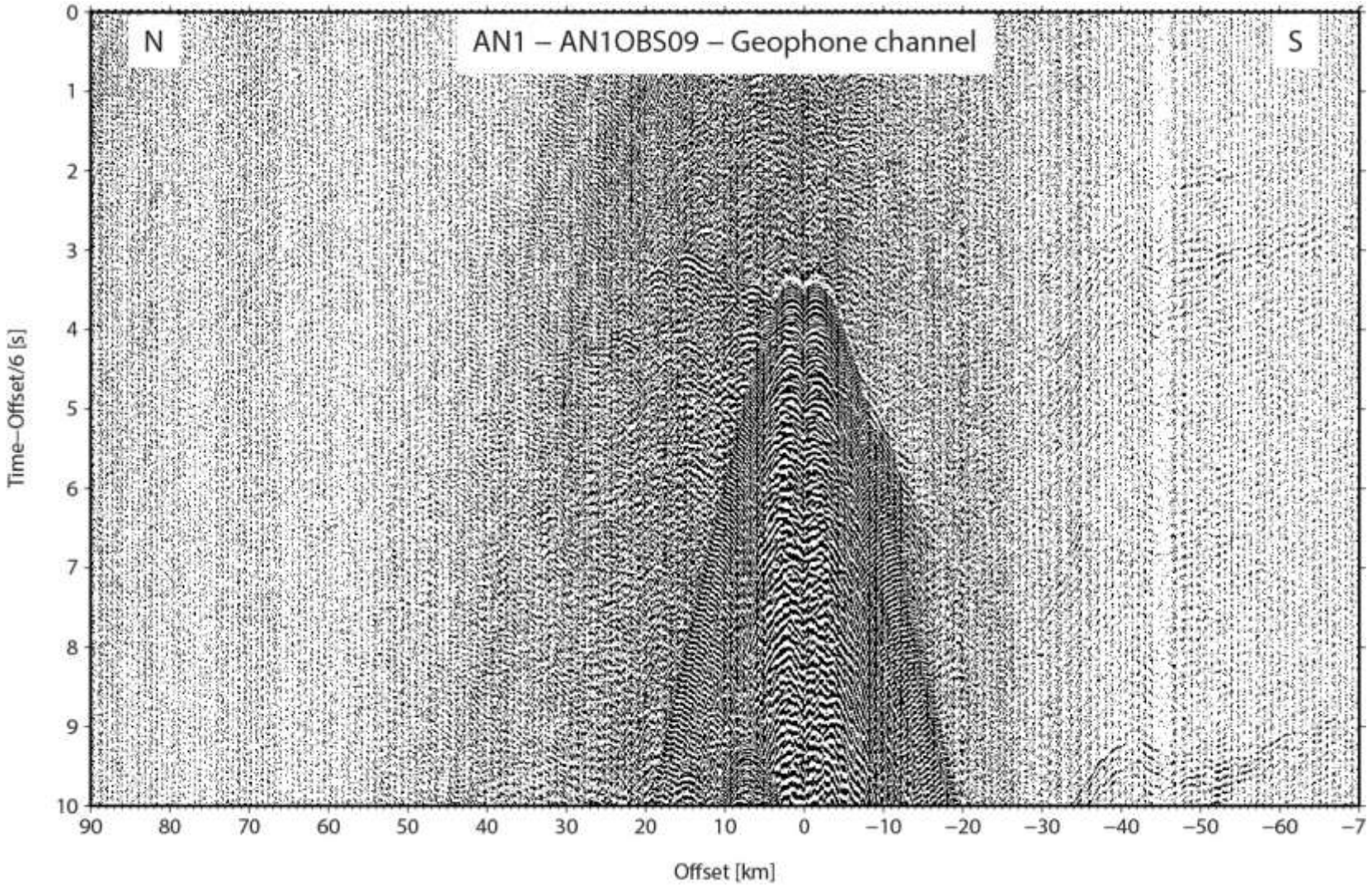
−40
−50
−60
−7
Offset [km]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AN1 – AN1OBS09 – Geophone channel
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Time–Offset/6 [s]
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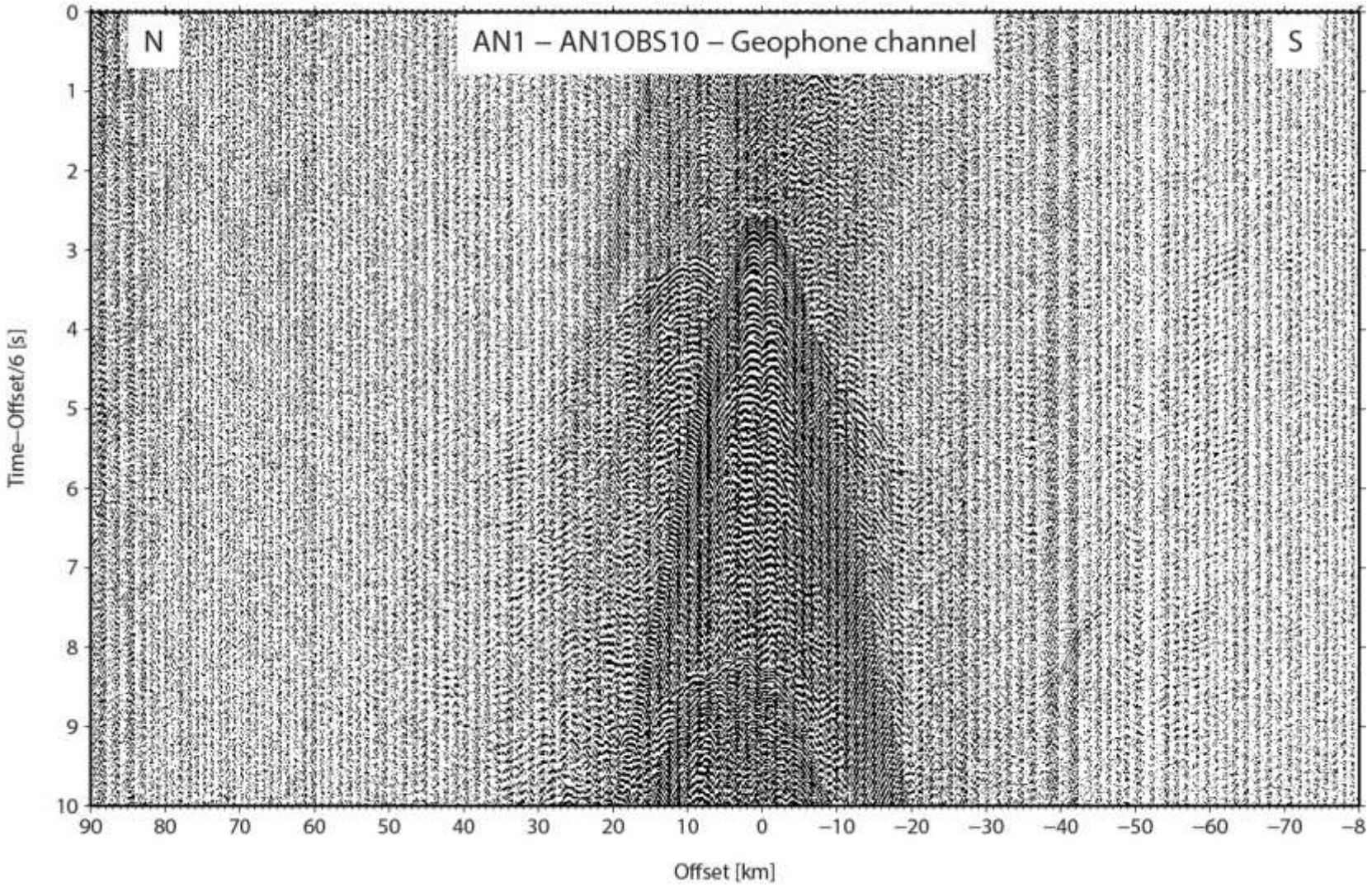
−60
−7
Offset [km]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AN1 – AN1OBS10 – Geophone channel
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Time–Offset/6 [s]
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10
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−10
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−50
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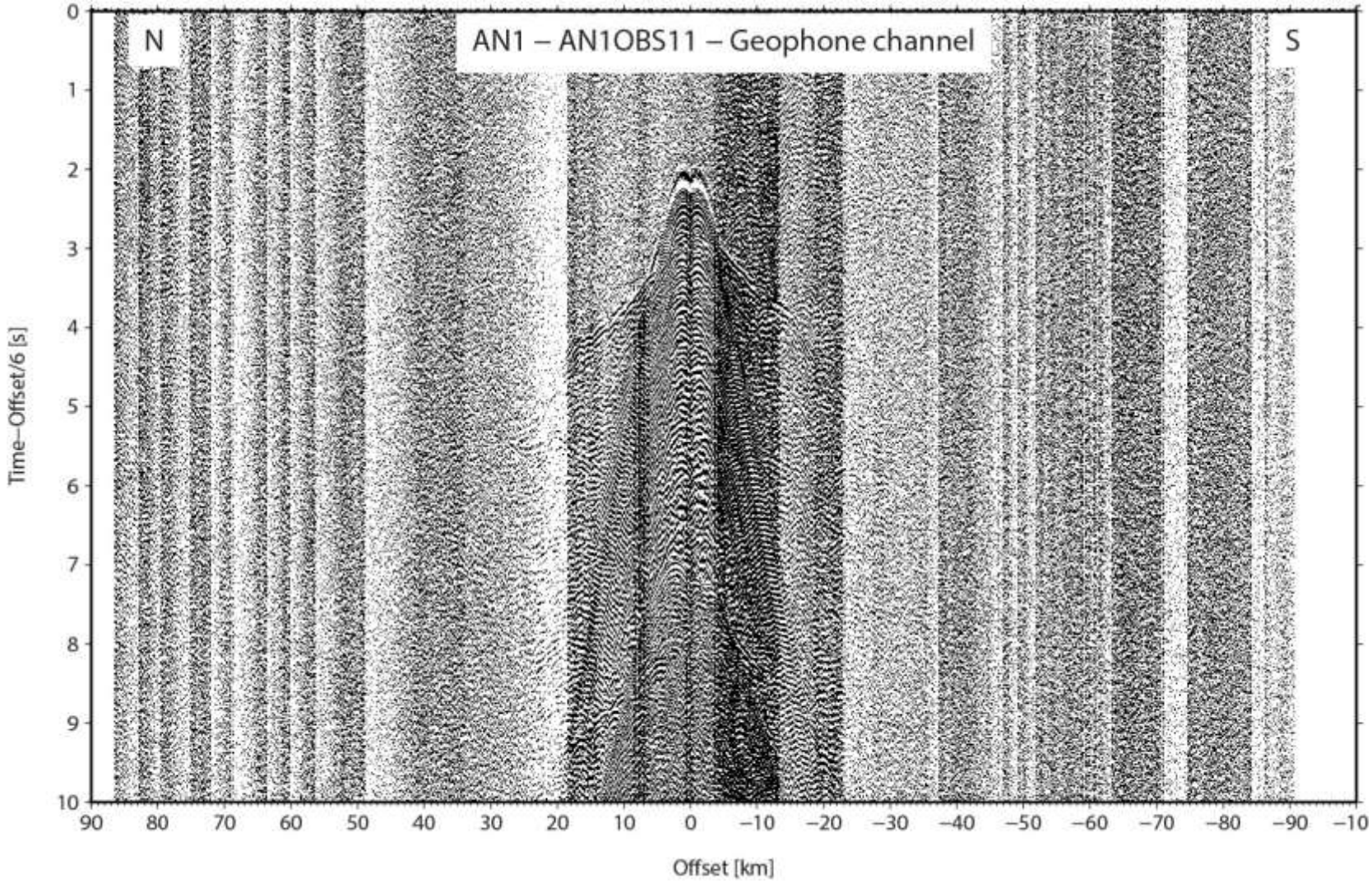
−70
−8
Offset [km]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Time–Offset/6 [s]
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−10
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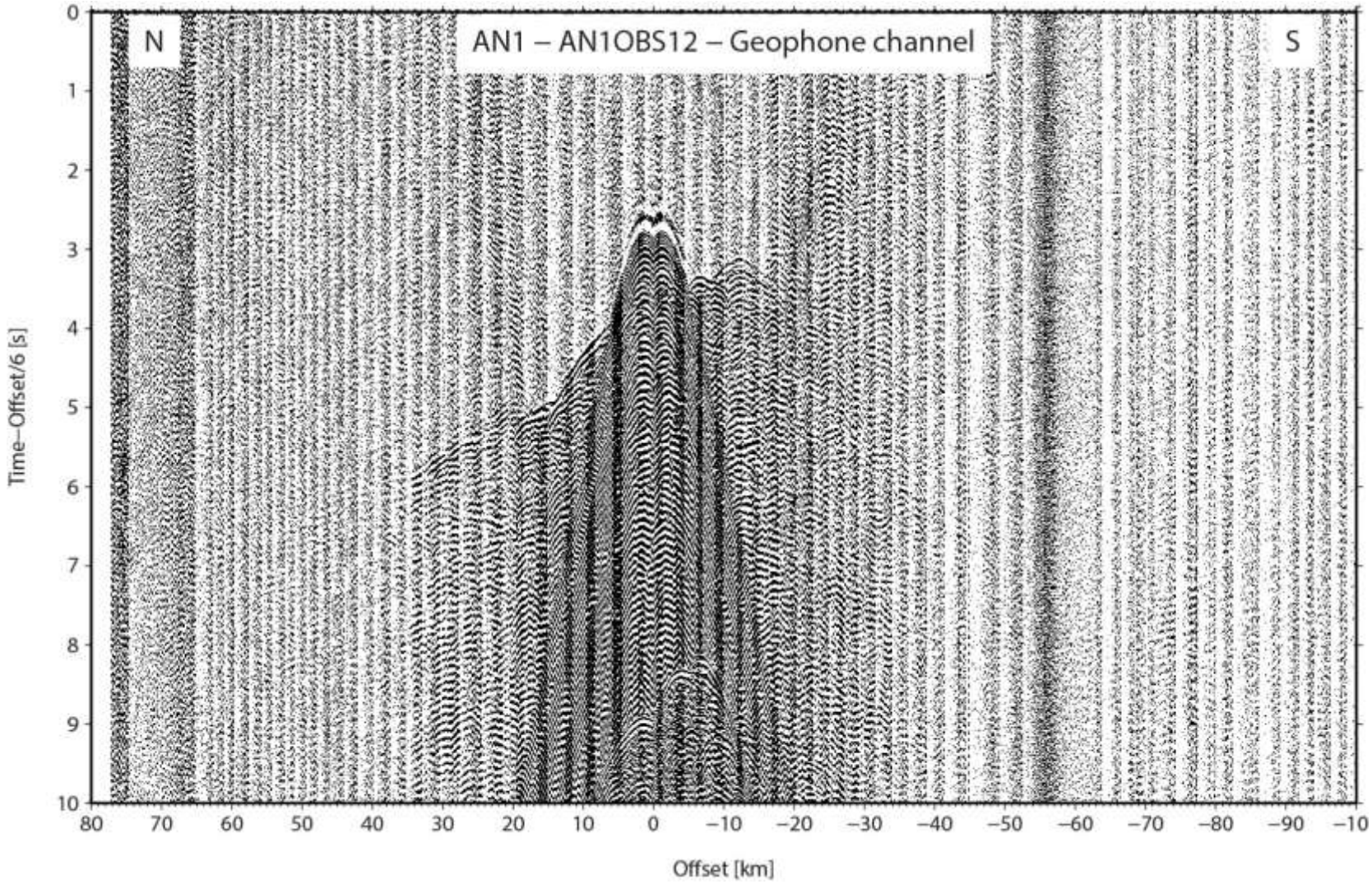
−30
−40
−50
−60
−70
−80
−90
−10
Offset [km]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Time–Offset/6 [s]
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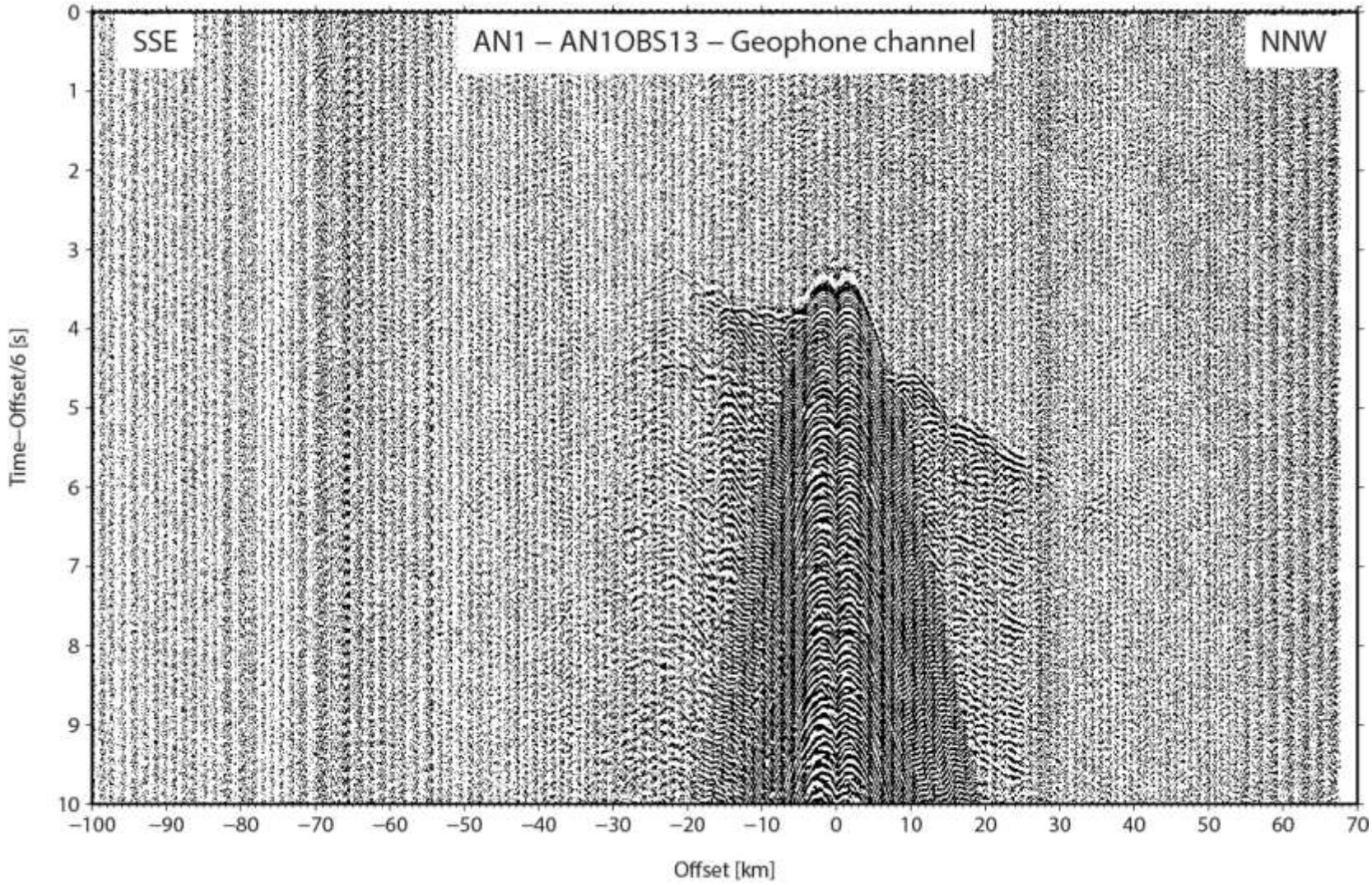
−70
−80
−90
−10
Offset [km]


SSE
AN1 – AN1OBS13 – Geophone channel
NNW
Time–Offset/6 [s]
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−100
−90
−80
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−50
−40
−30
−20
−10
0
10
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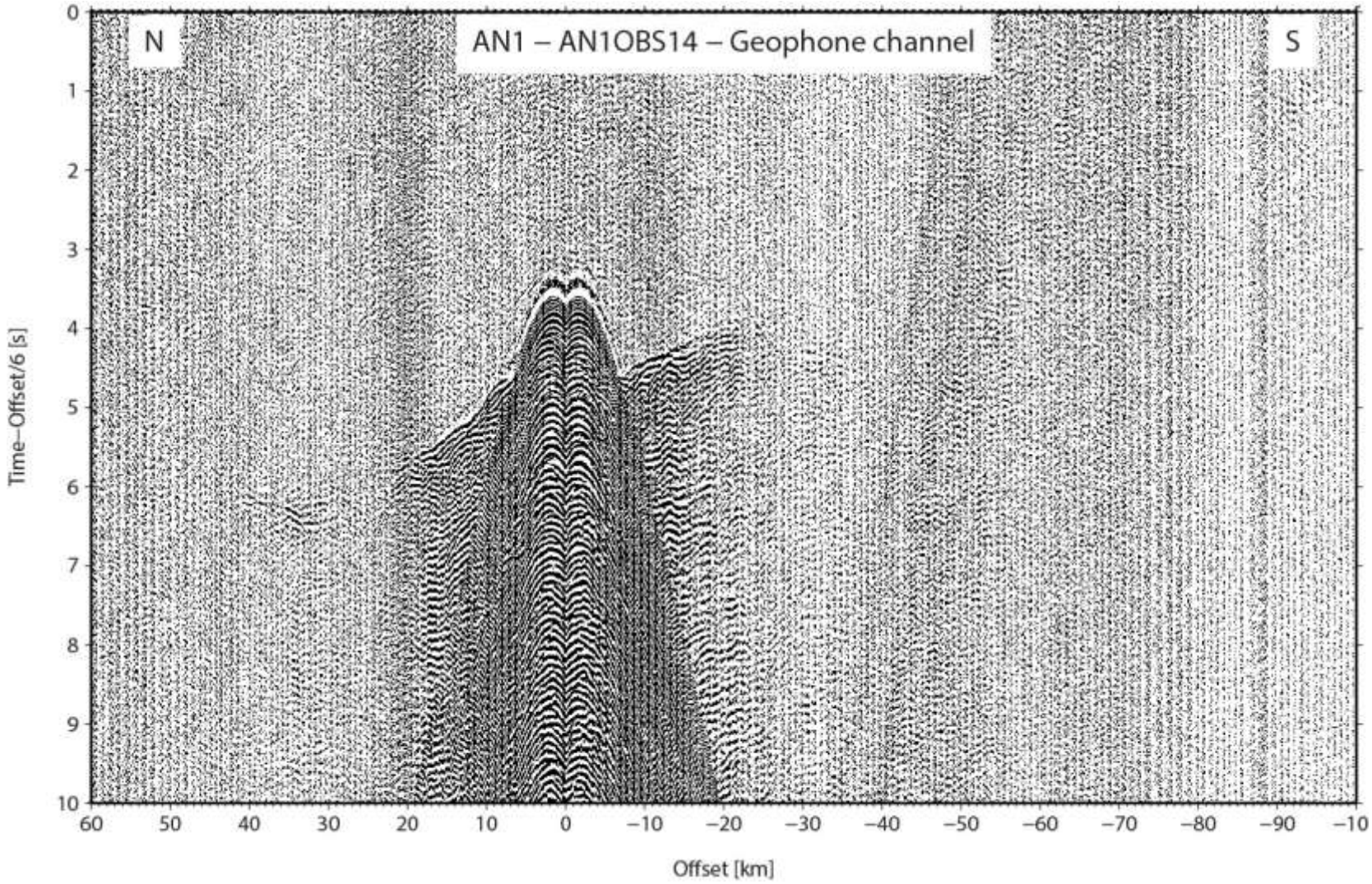
40
50
60
70
Offset [km]


N
AN1 – AN1OBS14 – Geophone channel
S
Time–Offset/6 [s]
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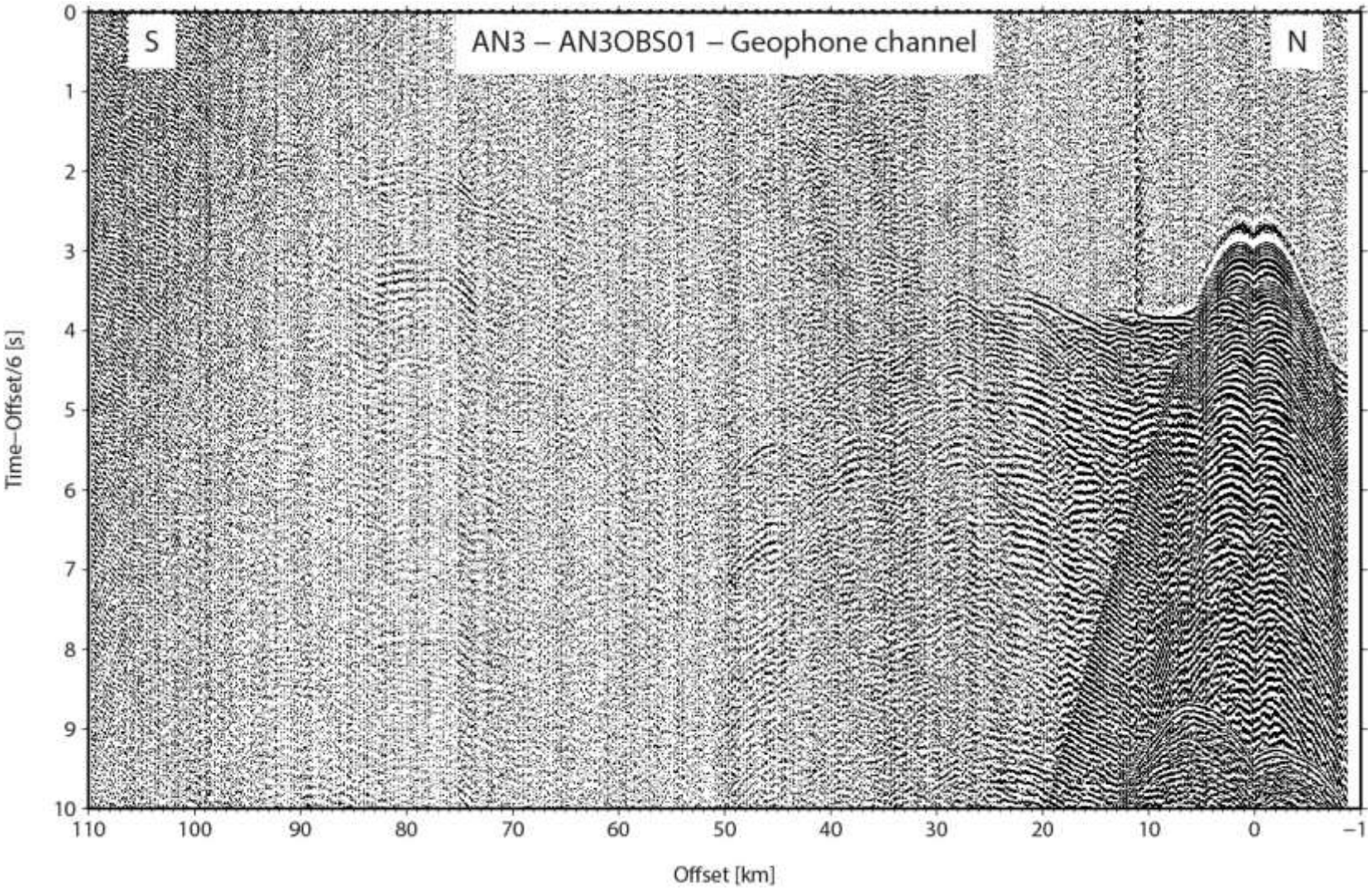
−30
−40
−50
−60
−70
−80
−90
−10
Offset [km]


S
AN3 – AN3OBS01 – Geophone channel
N
Time–Offset/6 [s]
0
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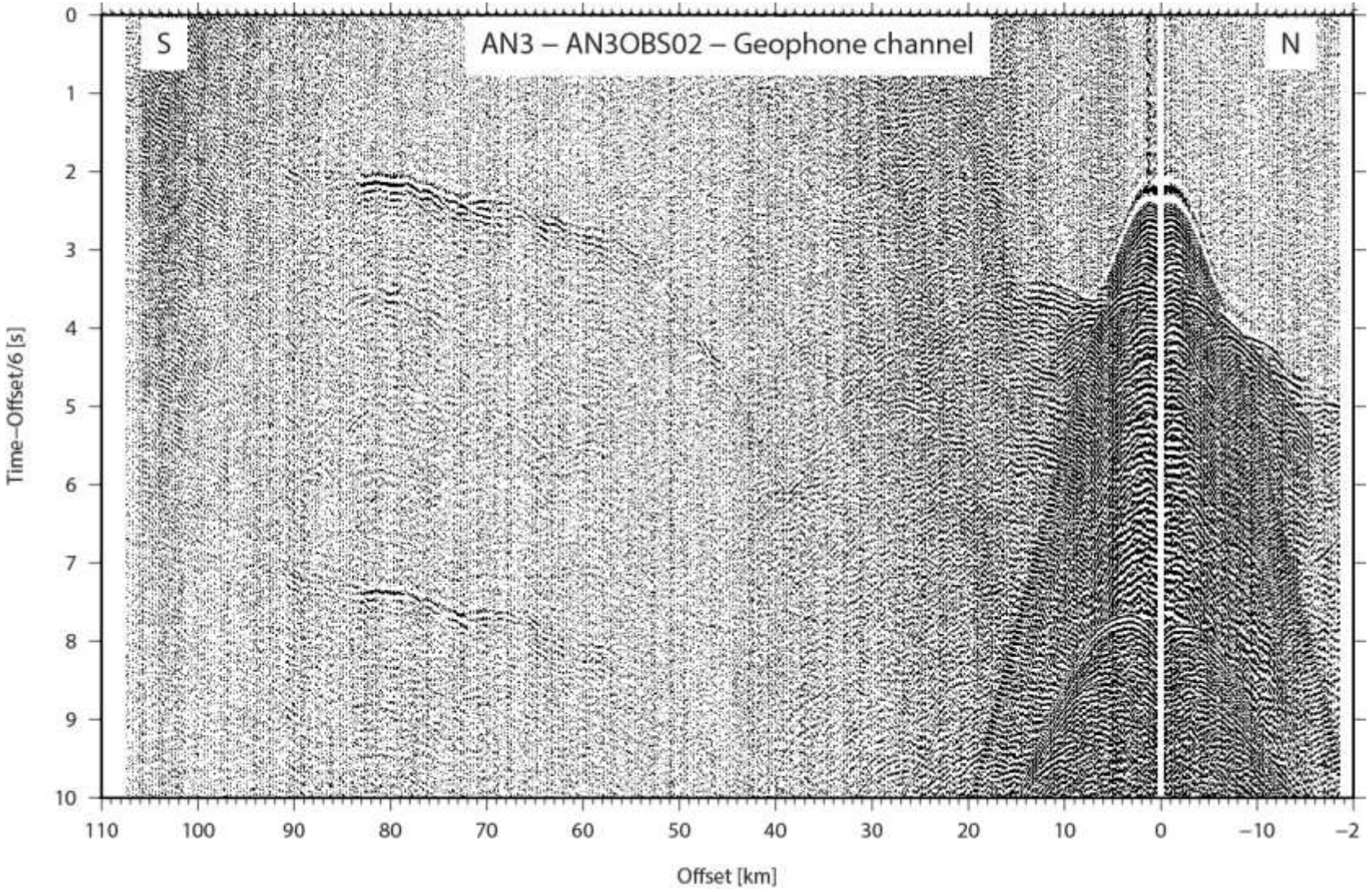
10
110
100
90
80
70
60
50
40
30
20
10
0
−1
Offset [km]


S
AN3 – AN3OBS02 – Geophone channel
N
Time–Offset/6 [s]
0
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20
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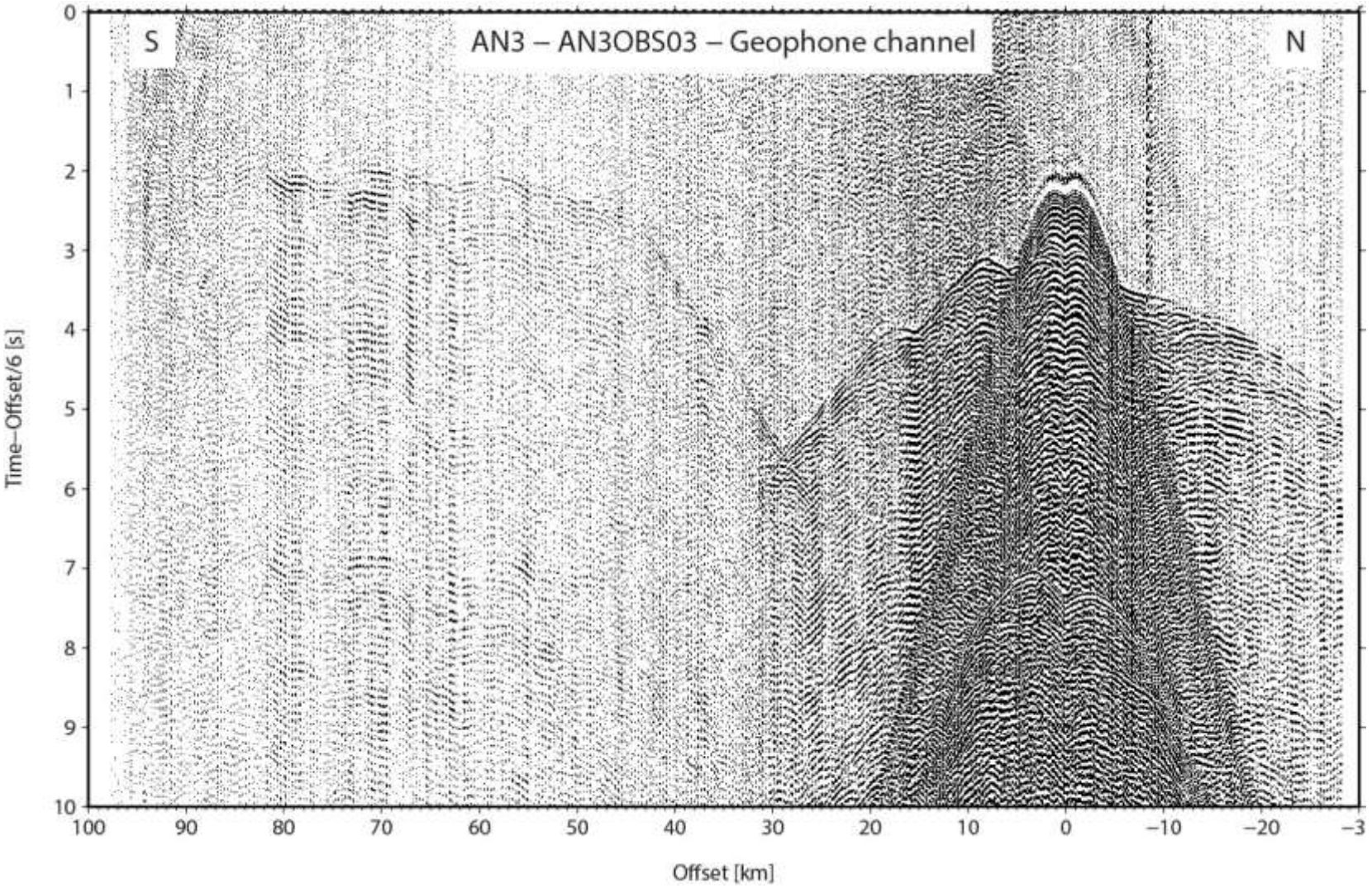
−10
−2
Offset [km]


S
AN3 – AN3OBS03 – Geophone channel
N
Time–Offset/6 [s]
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2
3
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5
6
7
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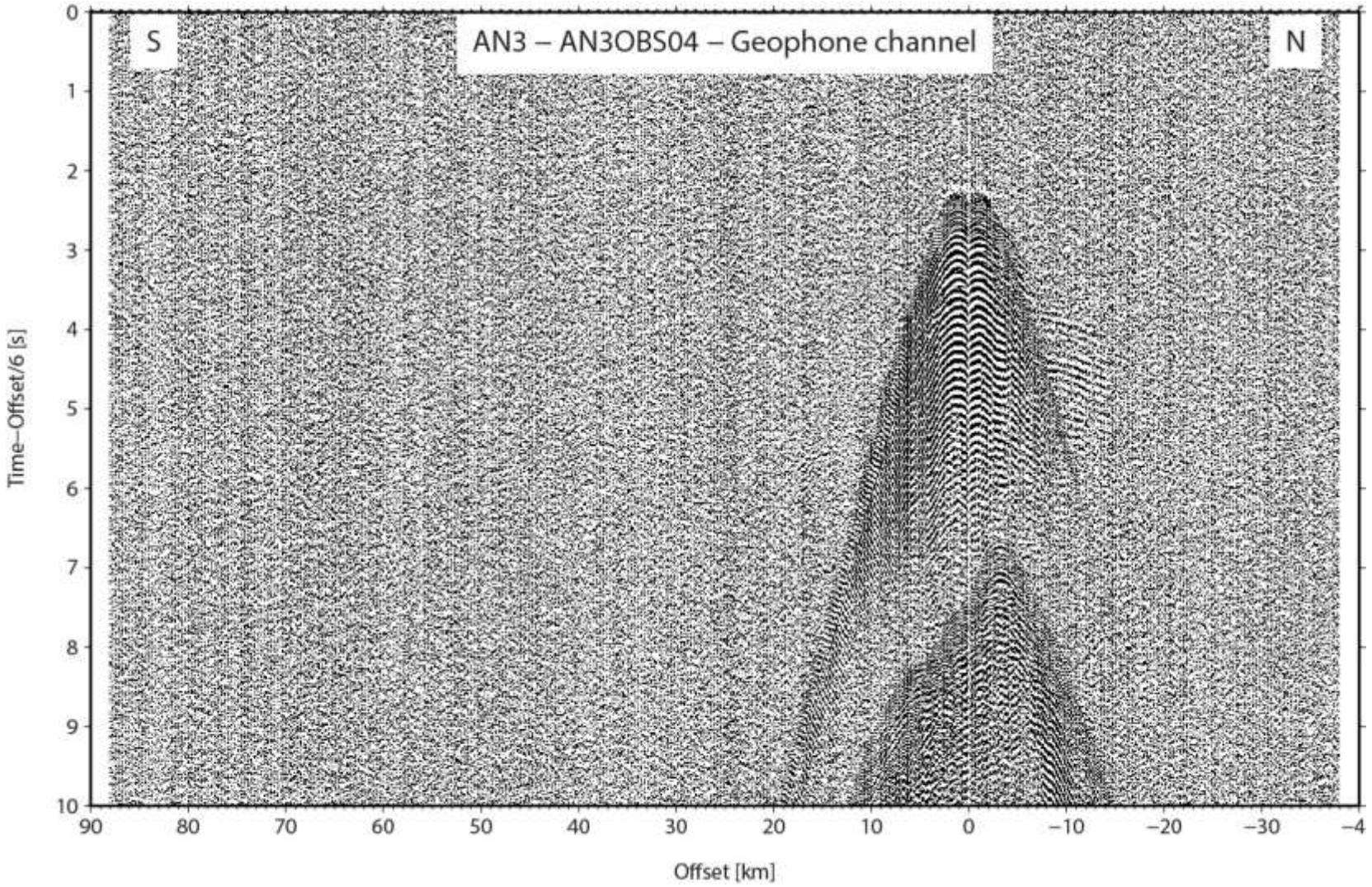
90
80
70
60
50
40
30
20
10
0
−10
−20
−3
Offset [km]


S
AN3 – AN3OBS04 – Geophone channel
N
Time–Offset/6 [s]
0
1
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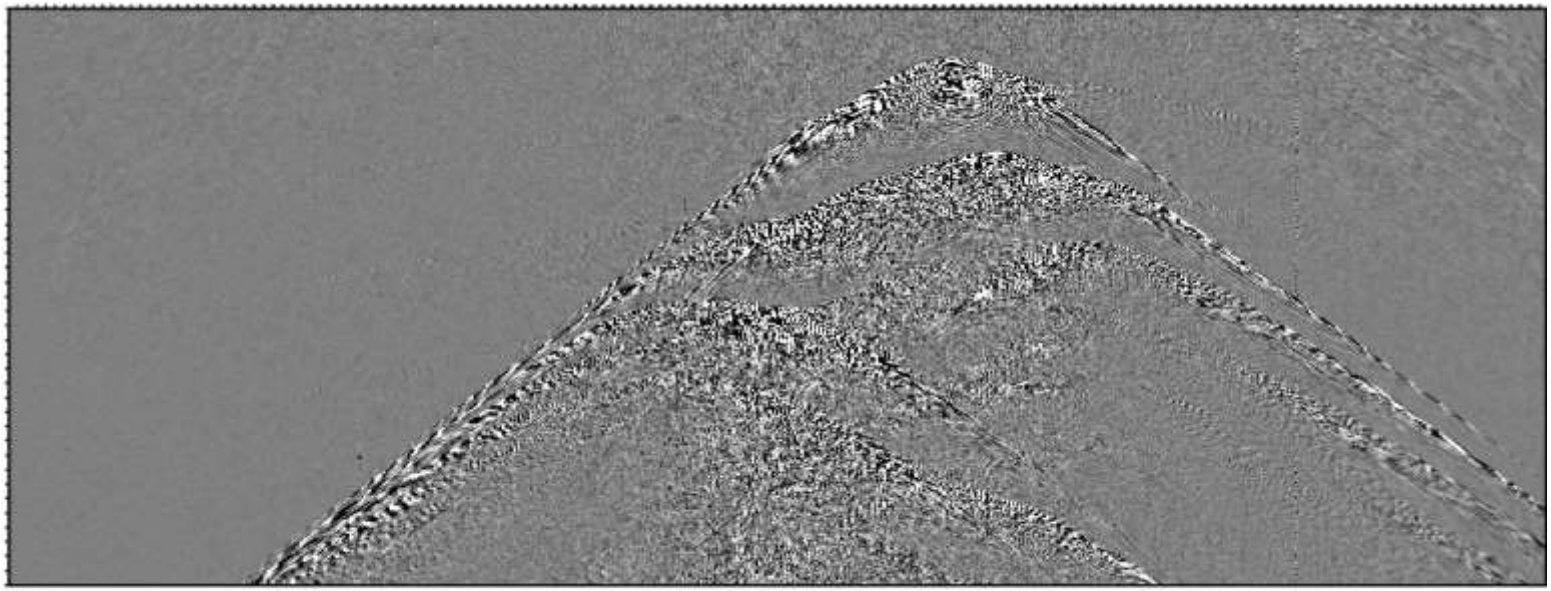
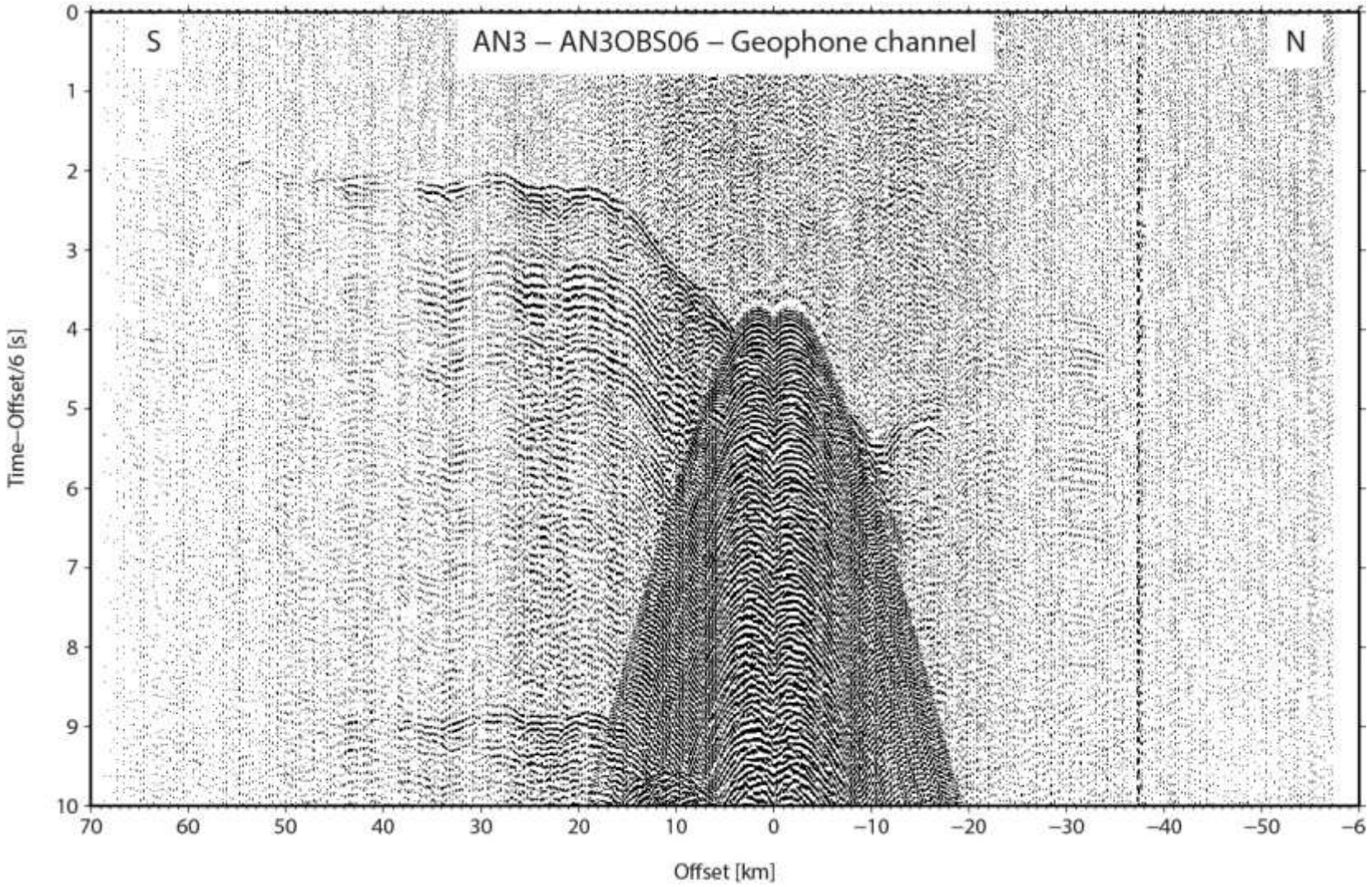
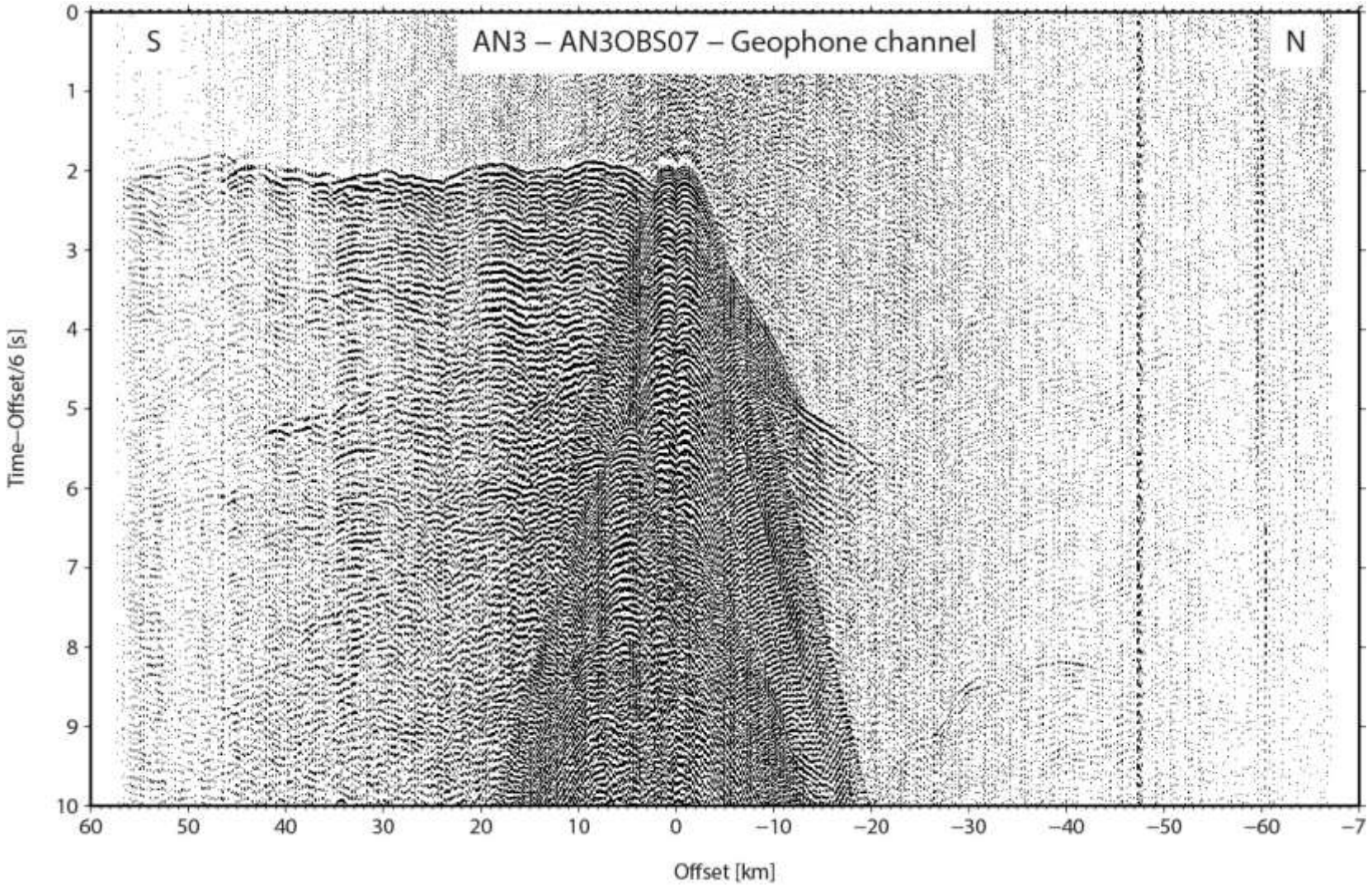
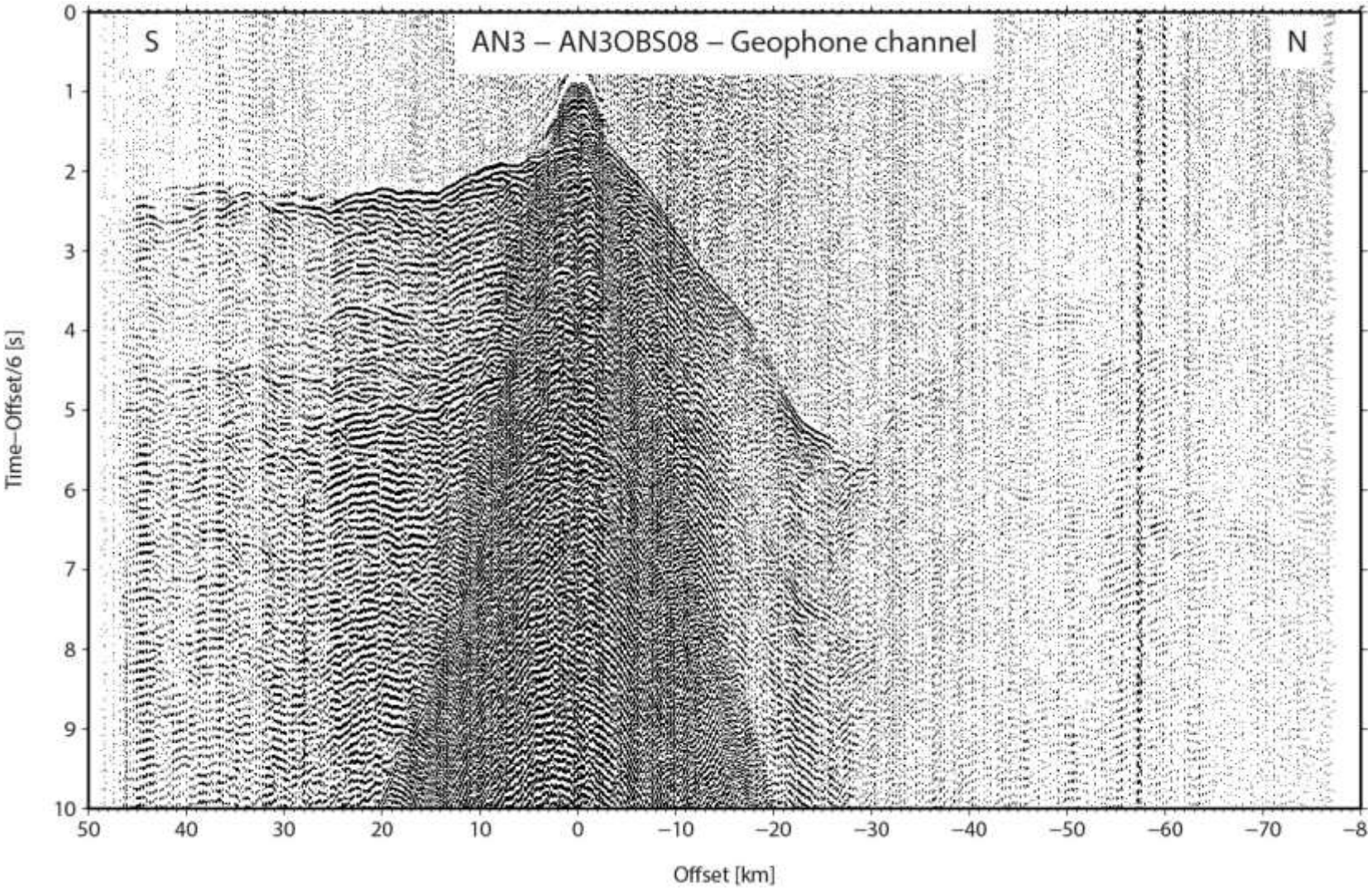
5
6
7
8
9
10
90
80
70
60
50
40
30
20
10
0
−10
−20
−30
−4
Offset [km]

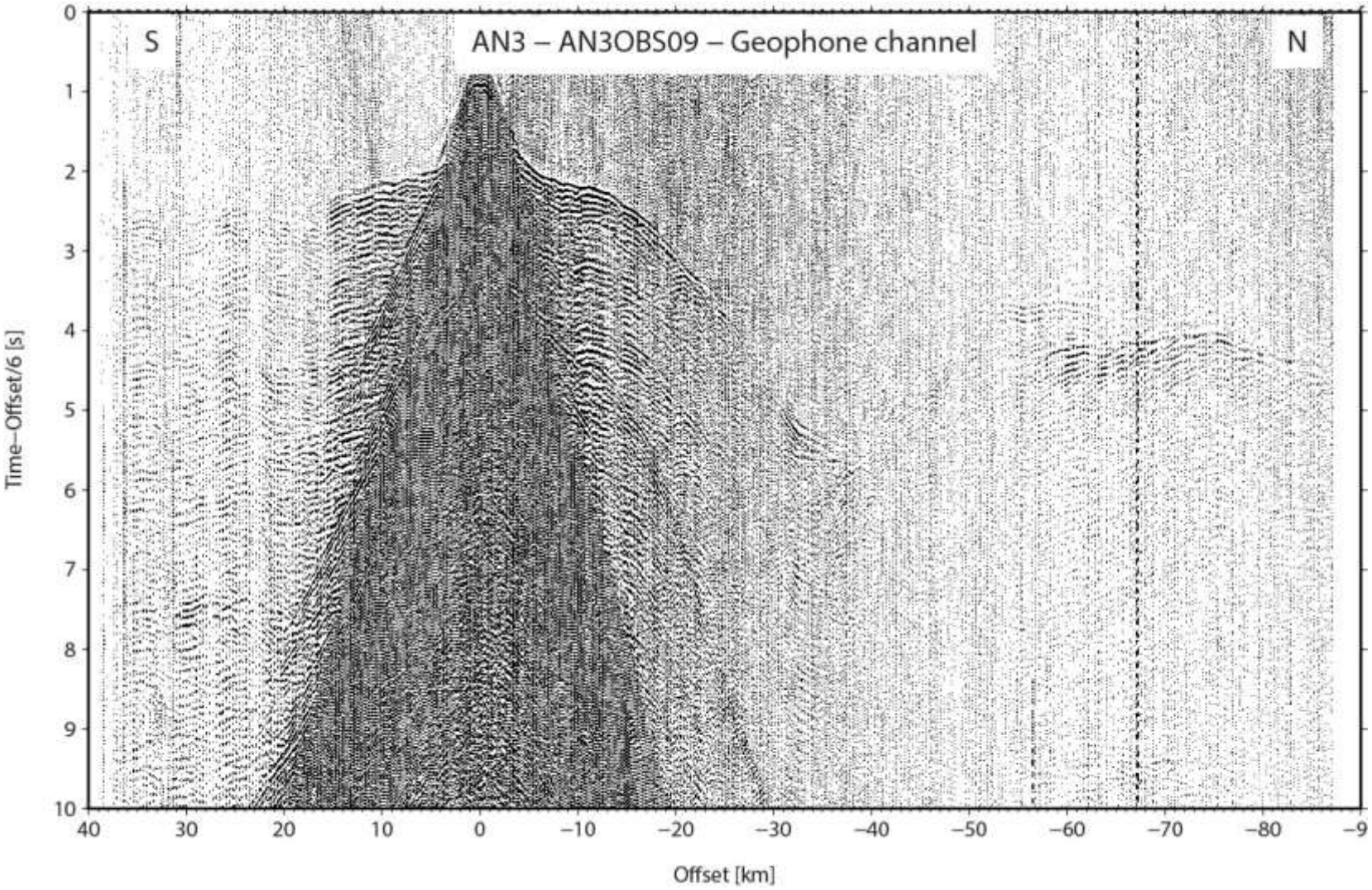
AN3 – AN3OBS05 – Geophone Channel

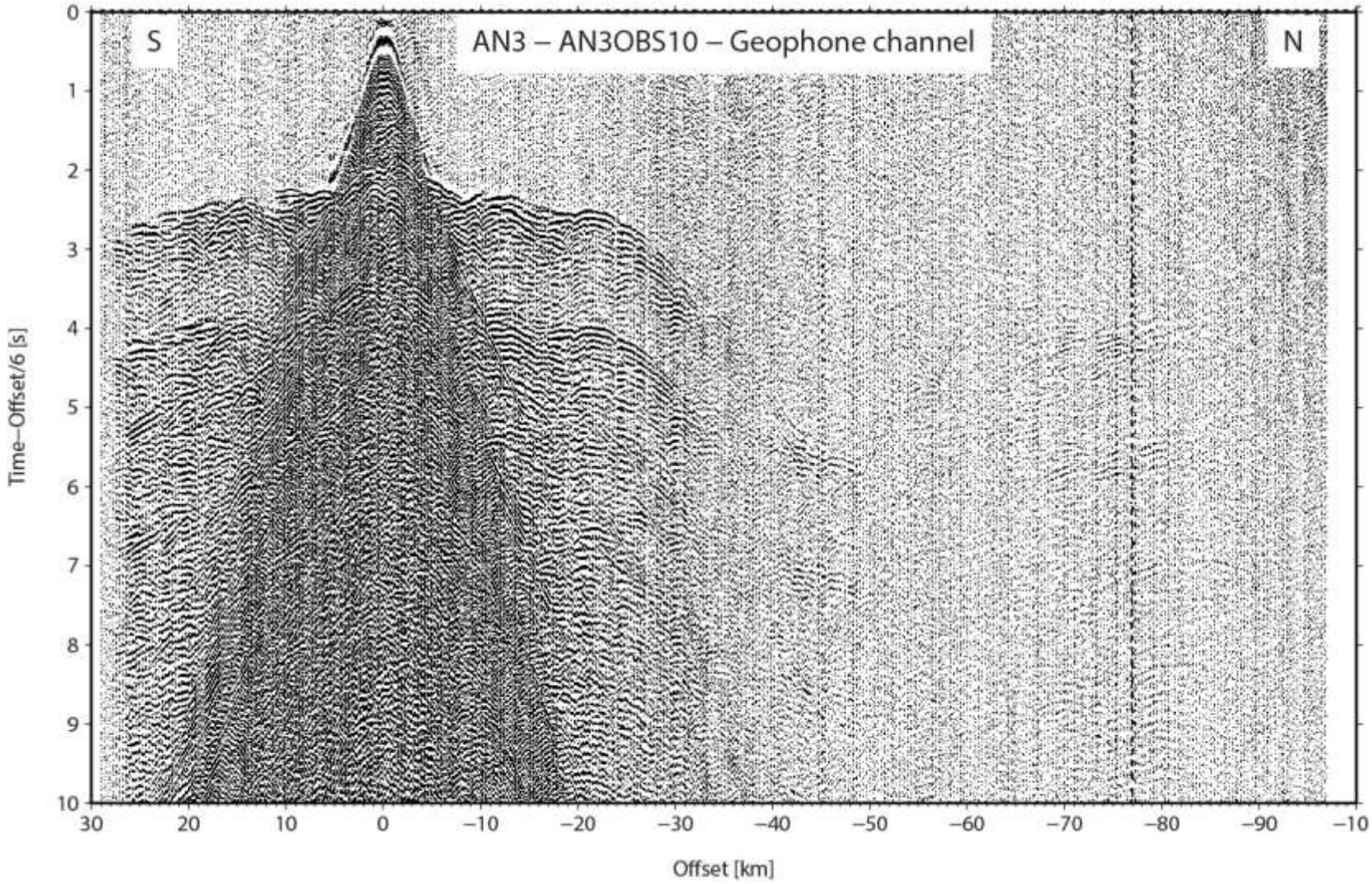


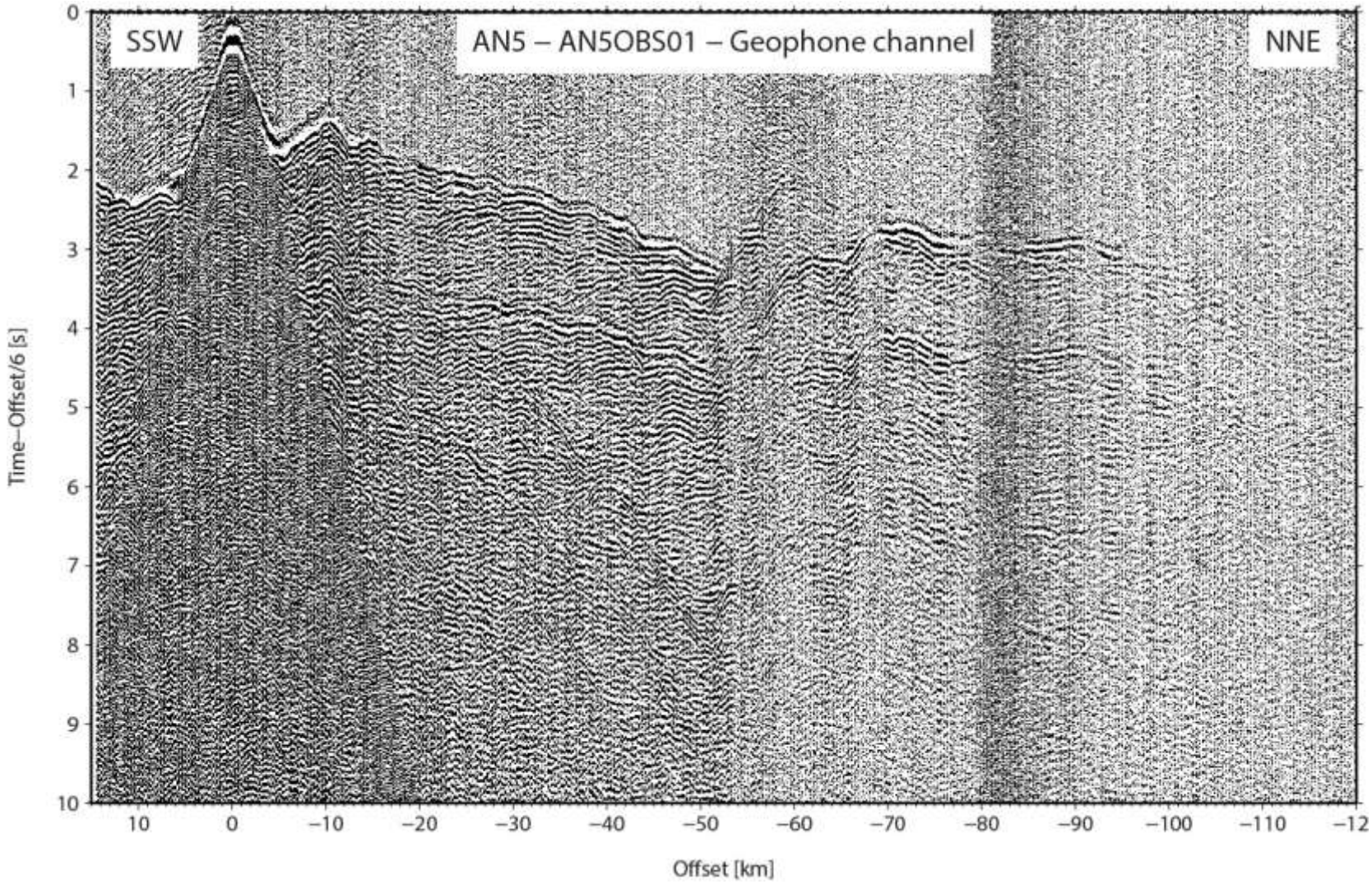

S
AN3 – AN3OBS06 – Geophone channel
N
Time–Offset/6 [s]
0
1
2
3
4
5
6
7
8
9
10
70
60
50
40
30
20
10
0
−10
−20
−30
−40
−50
−6
Offset [km]

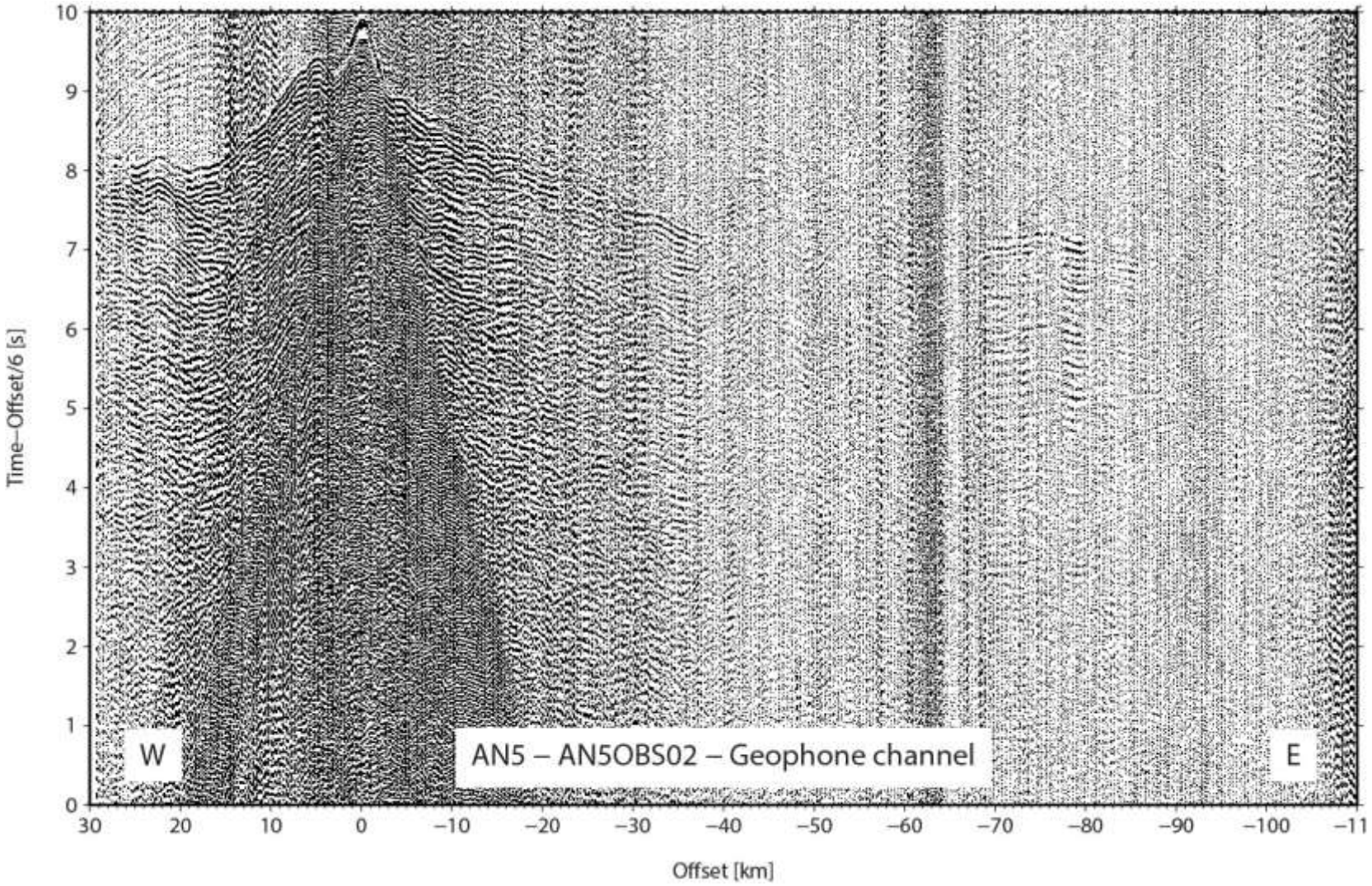

S
AN3 – AN3OBS07 – Geophone channel
N
Time–Offset/6 [s]
0
1
2
3
4
5
6
7
8
9
10
60
50
40
30
20
10
0
−10
−20
−30
−40
−50
−60
−7
Offset [km]

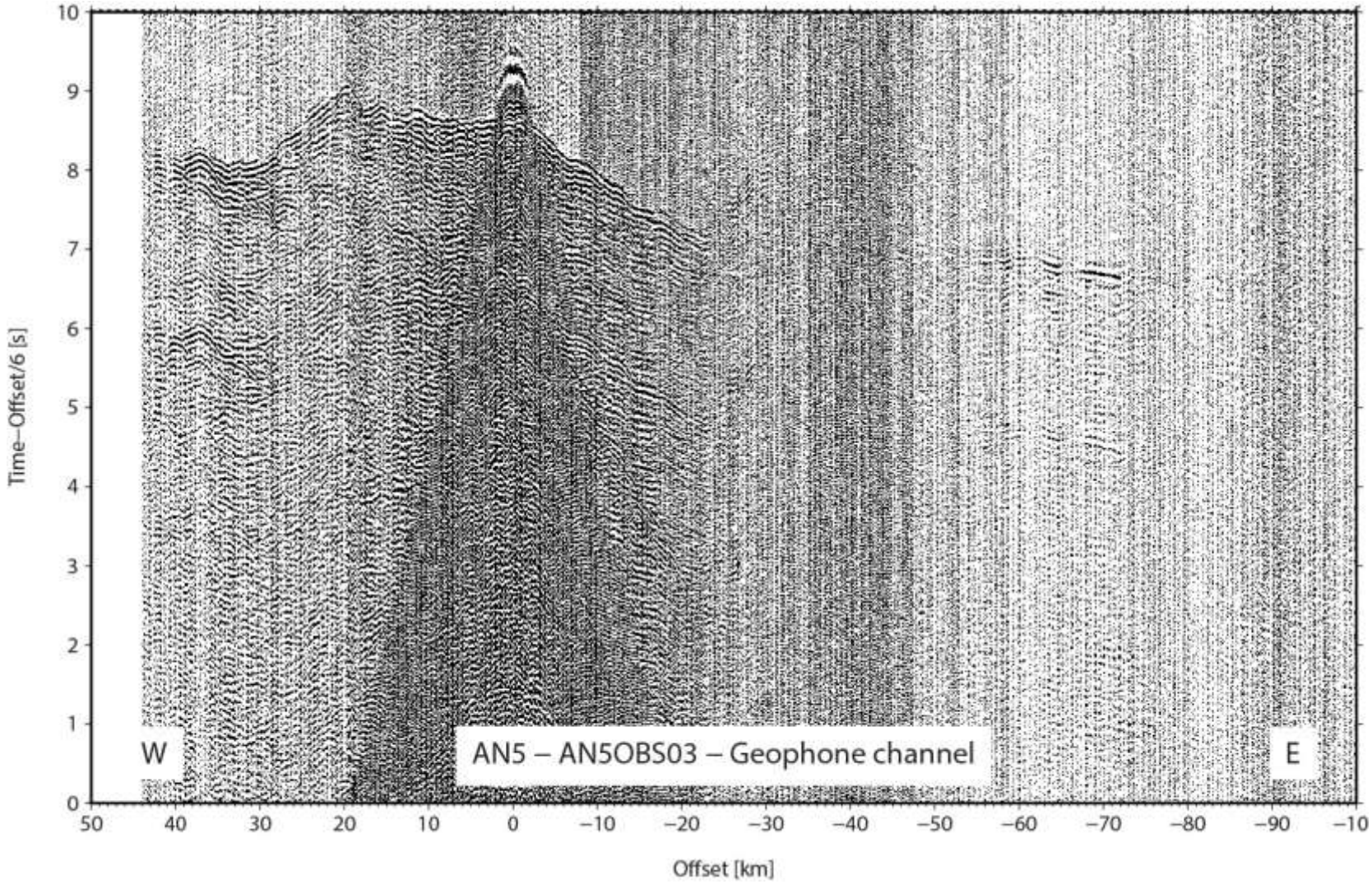

S
AN3 – AN3OBS08 – Geophone channel
N
Time–Offset/6 [s]
0
1
2
3
4
5
6
7
8
9
10
50
40
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
−8
Offset [km]

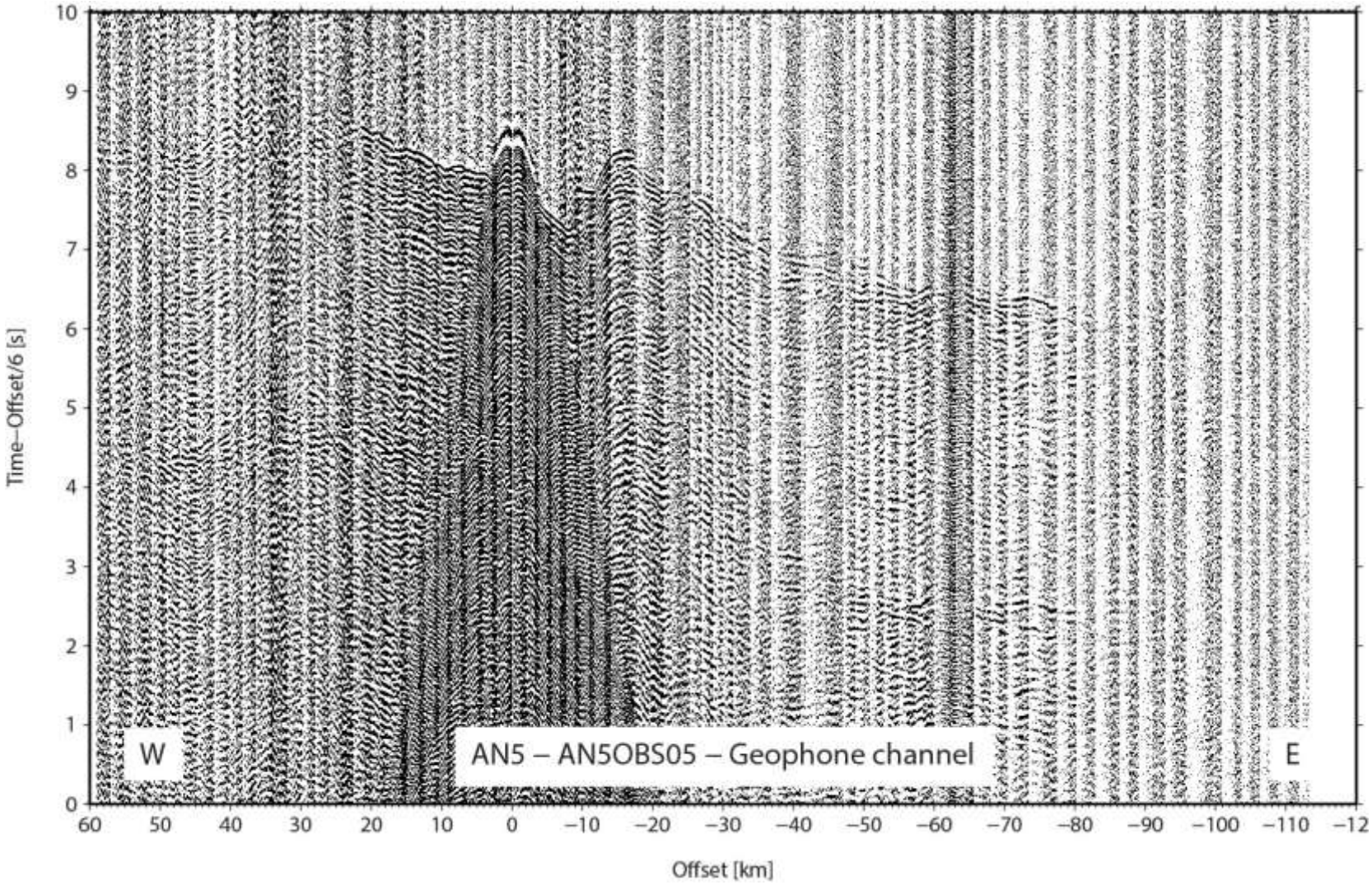

S
AN3 – AN3OBS09 – Geophone channel
N
Time–Offset/6 [s]
0
1
2
3
4
5
6
7
8
9
10
40
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
−80
−9
Offset [km]

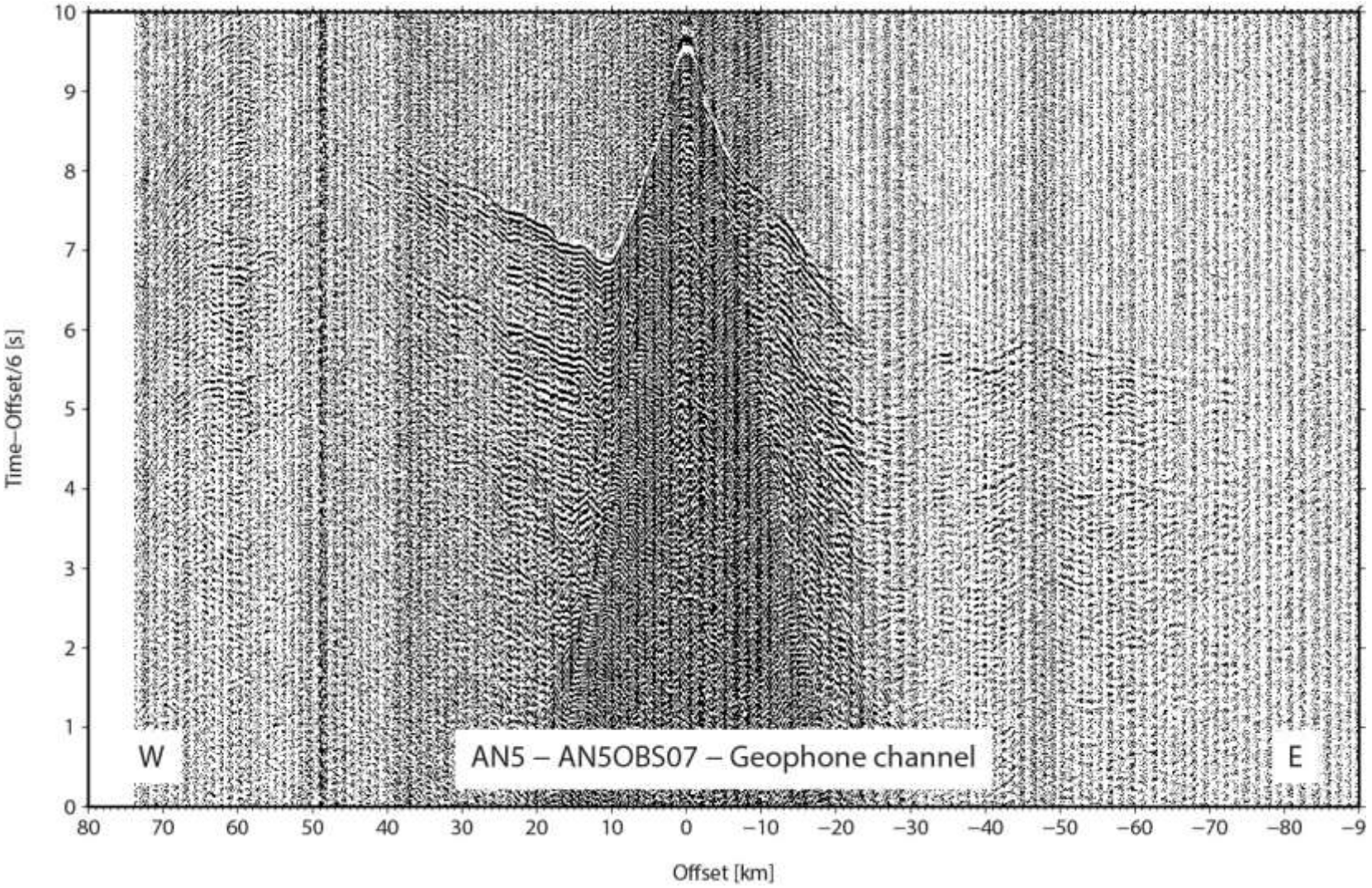

S
AN3 – AN3OBS10 – Geophone channel
N
Time–Offset/6 [s]
0
1
2
3
4
5
6
7
8
9
10
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
−80
−90
−10
Offset [km]

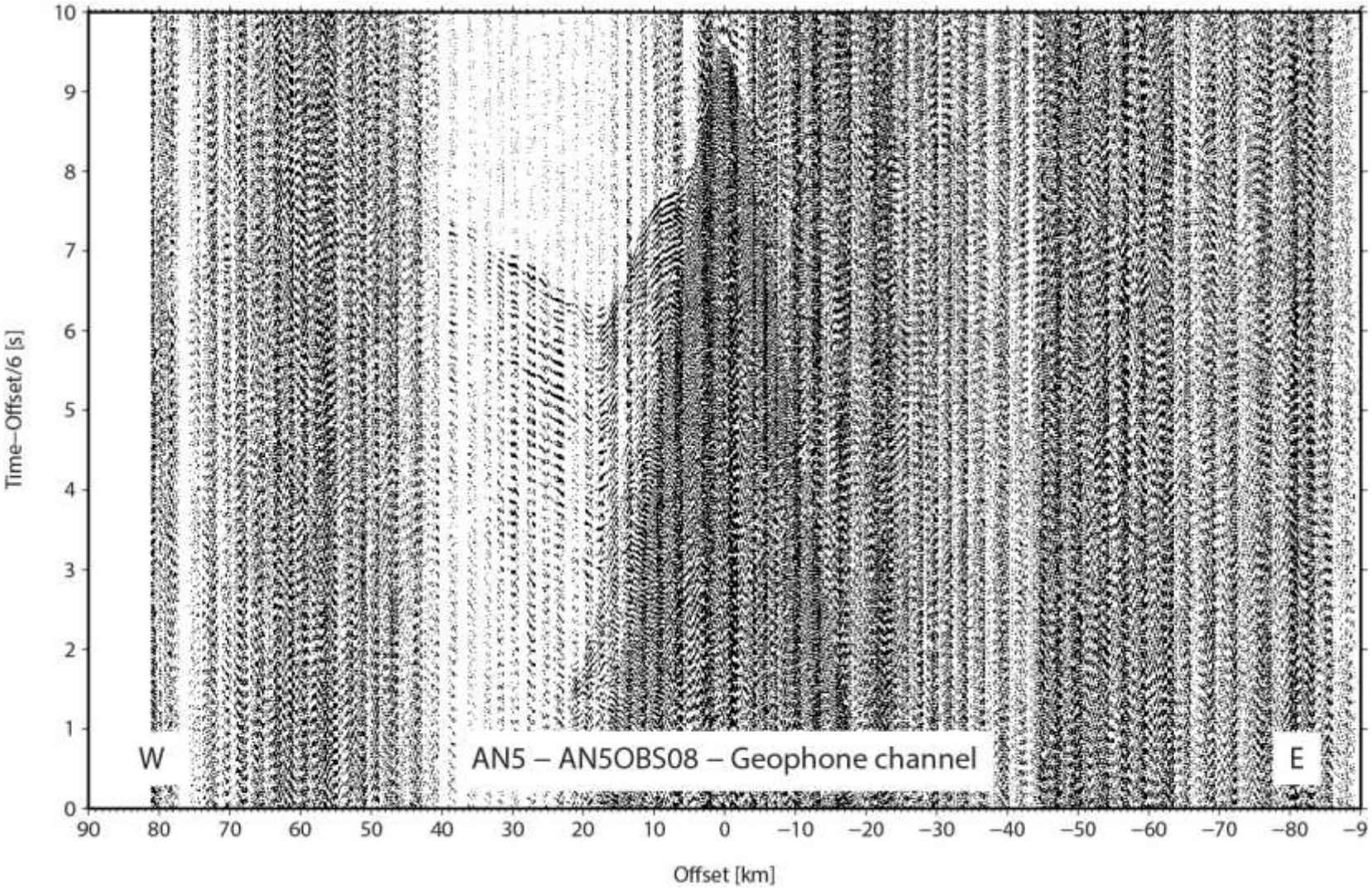

SSW
AN5 – AN5OBS01 – Geophone channel
NNE
Time–Offset/6 [s]
0
1
2
3
4
5
6
7
8
9
10
10
0
−10
−20
−30
−40
−50
−60
−70
−80
−90
−100
−110
−12
Offset [km]

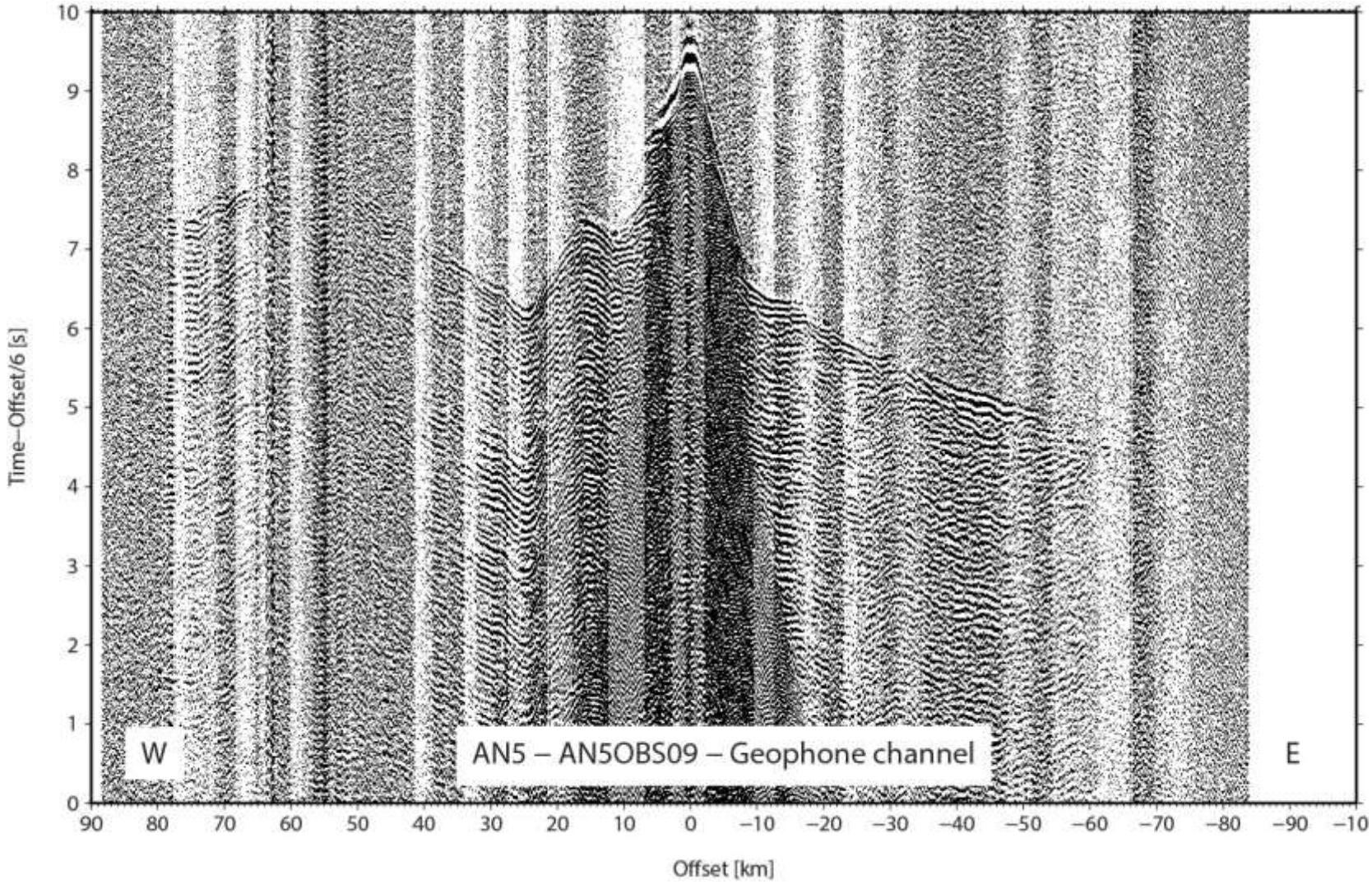

Time–Offset/6 [s]
10
9
8
7
6
5
4
3
2
1
0
W
AN5 – AN5OBS02 – Geophone channel
E
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
−80
−90
−100
−11
Offset [km]

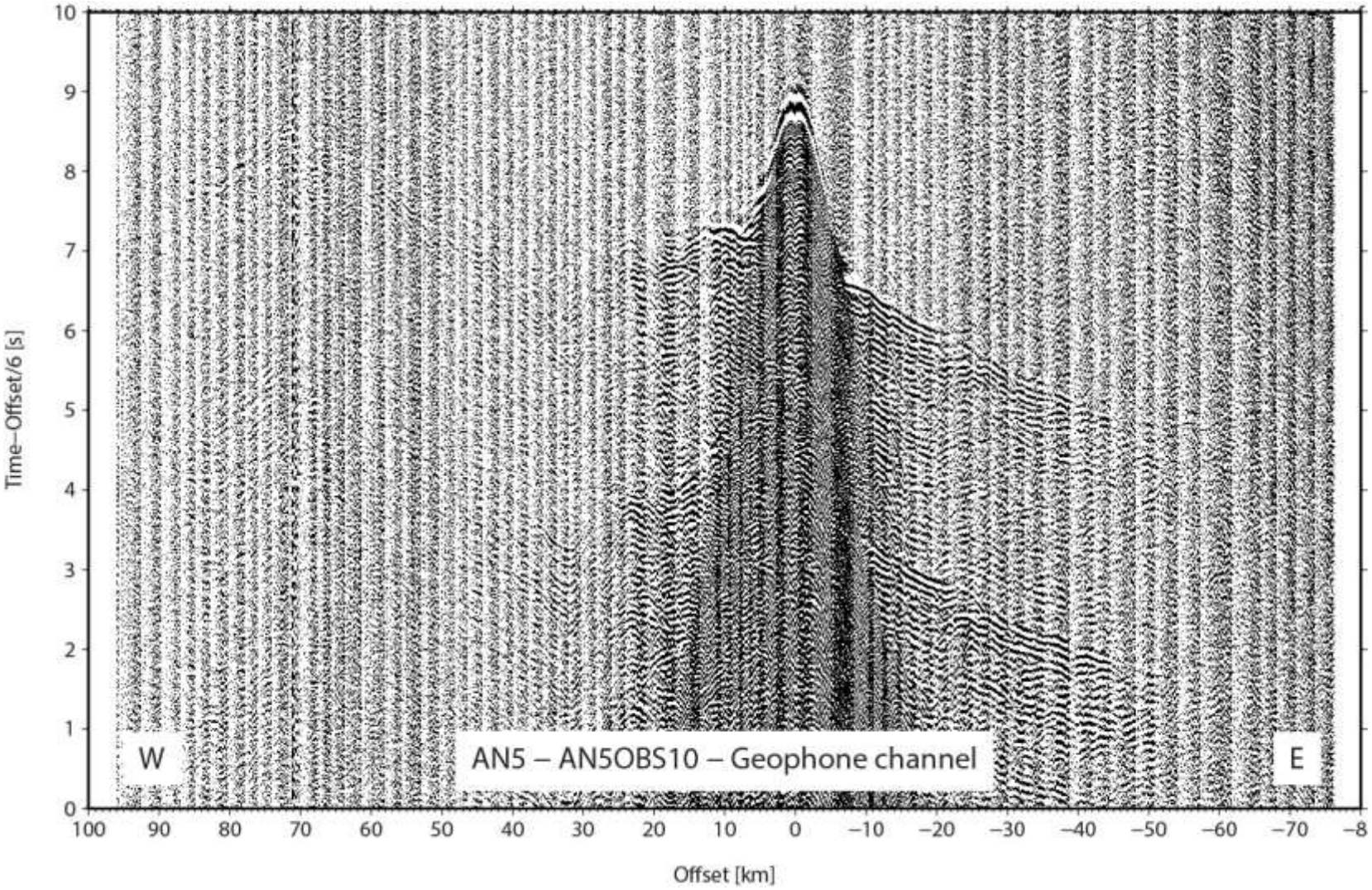

Time–Offset/6 [s]
10
9
8
7
6
5
4
3
2
1
0
W
AN5 – AN5OBS03 – Geophone channel
E
50
40
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
−80
−90
−10
Offset [km]

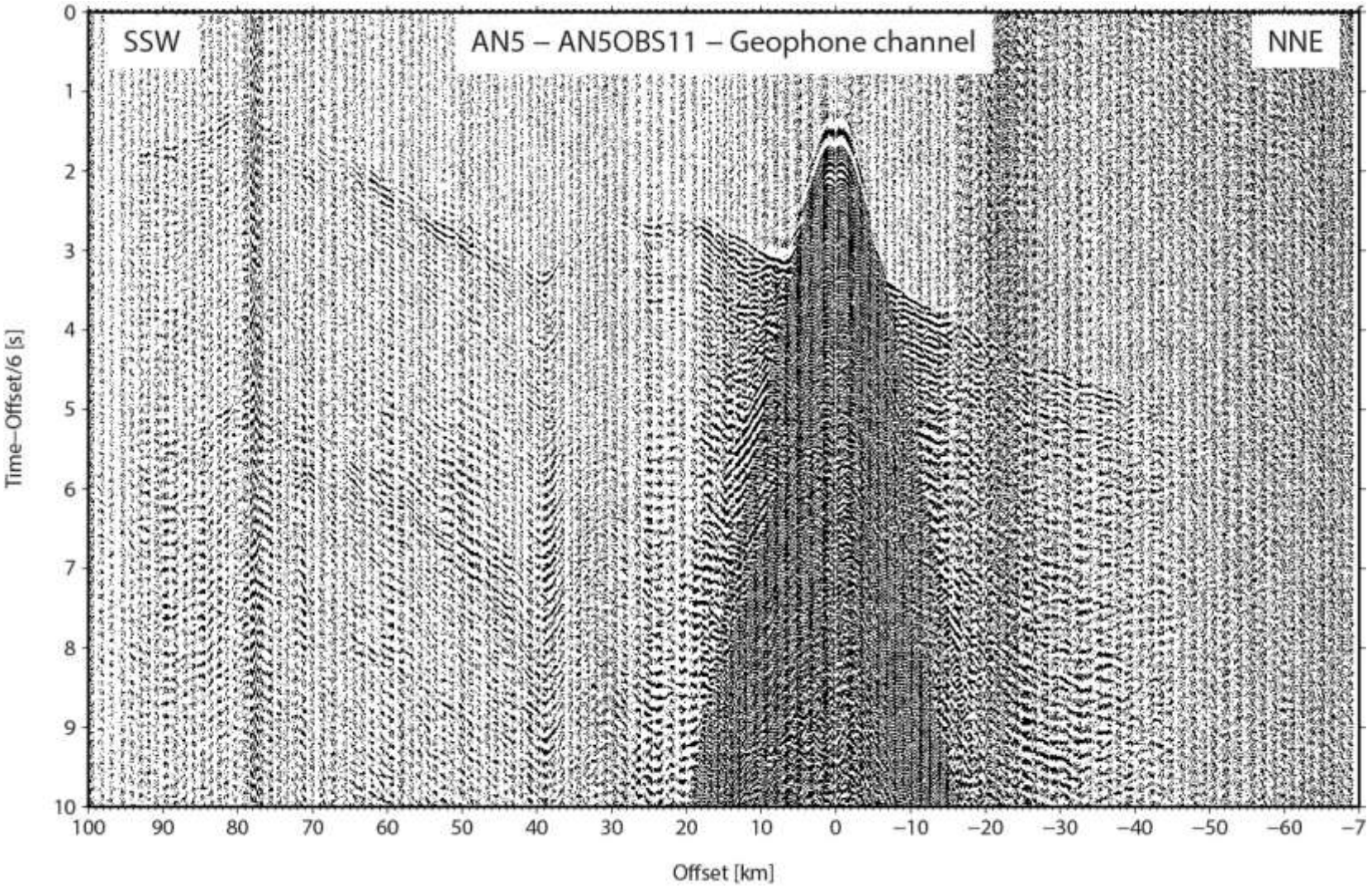

Time–Offset/6 [s]
10
9
8
7
6
5
4
3
2
1
0
W
AN5 – AN5OBS05 – Geophone channel
E
60
50
40
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
−80
−90
−100
−110
−12
Offset [km]

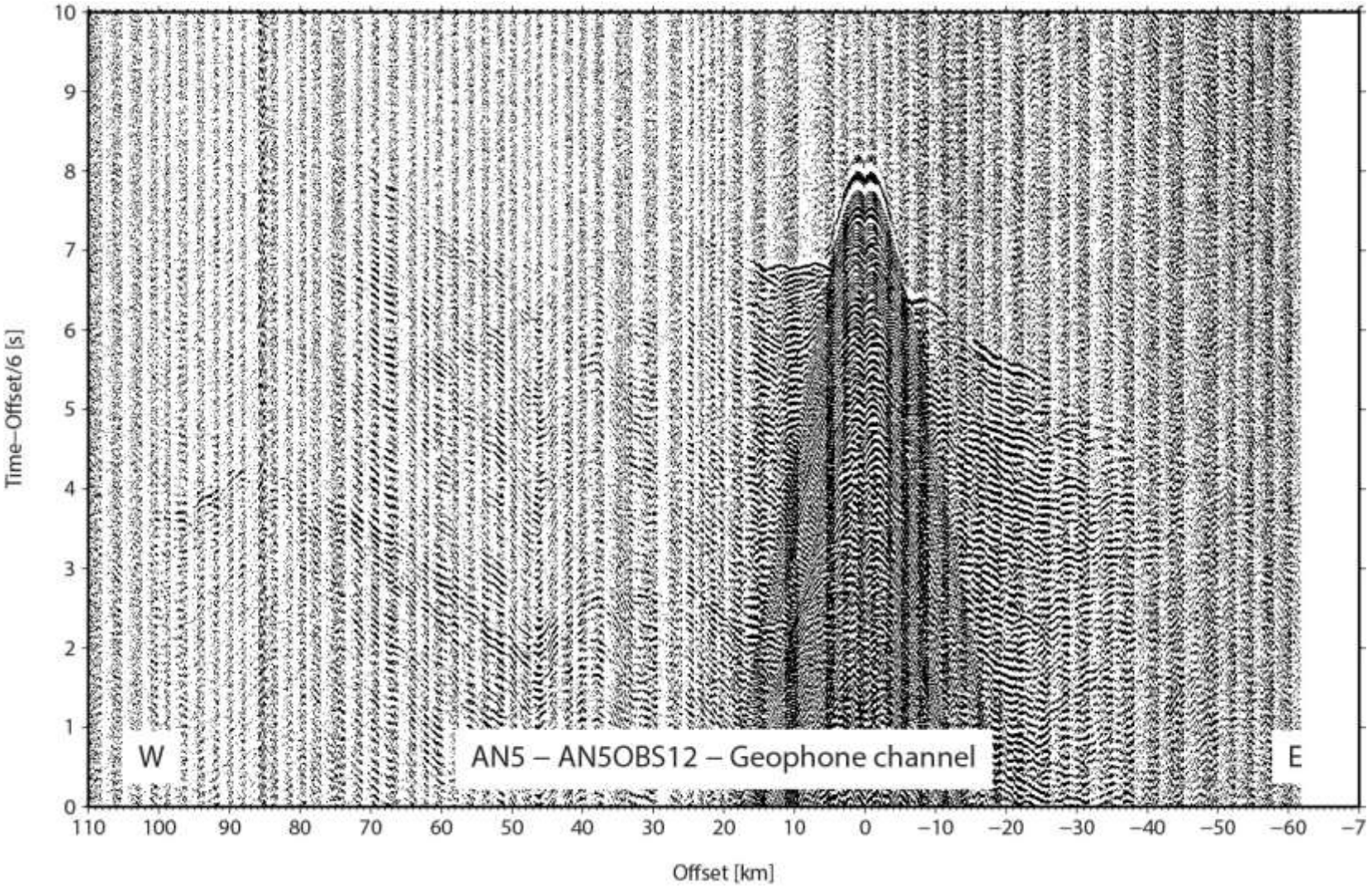

Time−Offset/6 [s]
10
9
8
7
6
5
4
3
2
1
0
W
AN5 – AN5OBS07 – Geophone channel
E
80
70
60
50
40
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
−80
−9
Offset [km]

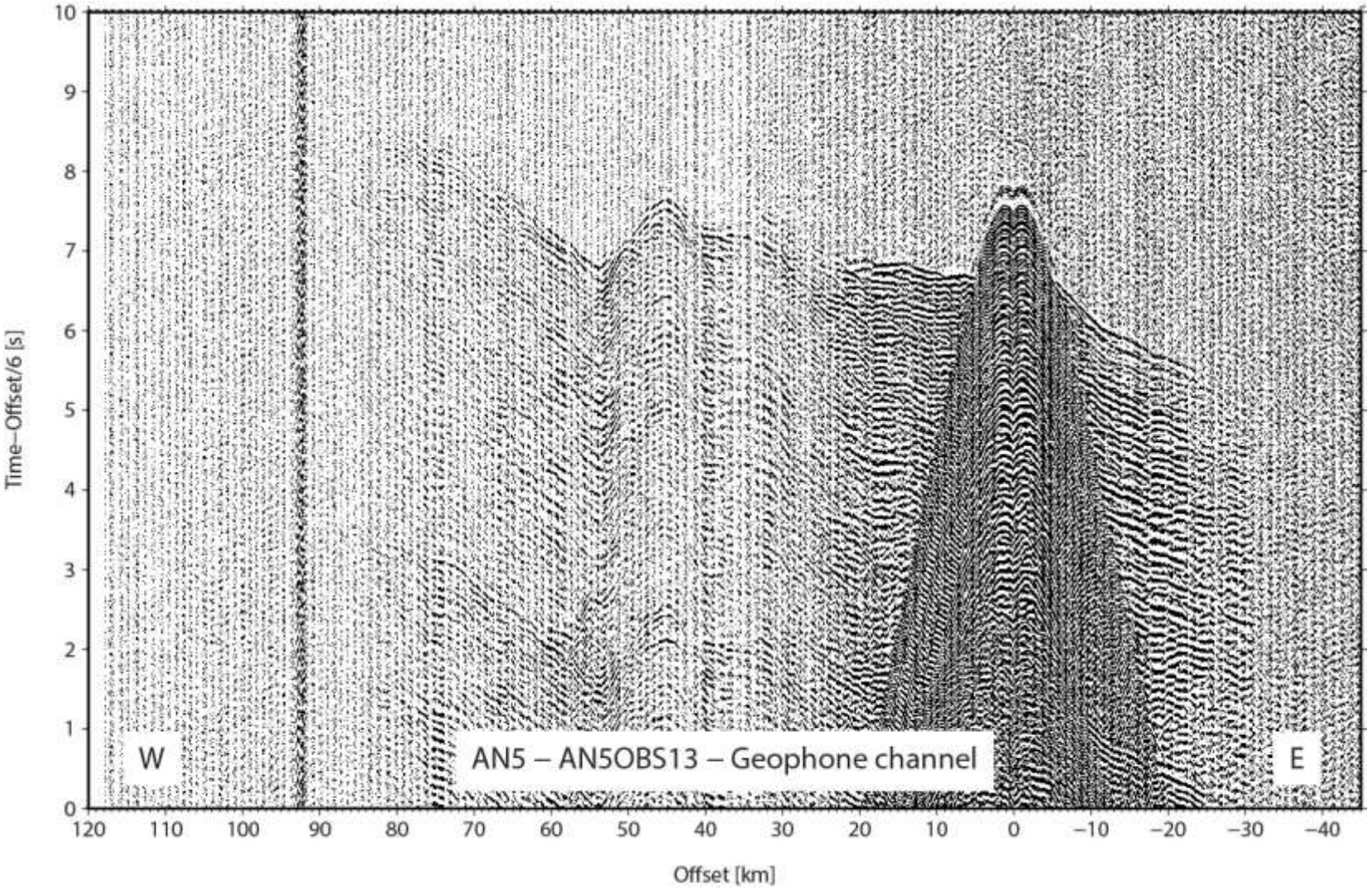

Time−Offset/6 [s]
10
9
8
7
6
5
4
3
2
1
0
W
AN5 – AN5OBS08 – Geophone channel
E
90
80
70
60
50
40
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
−80
−9
Offset [km]

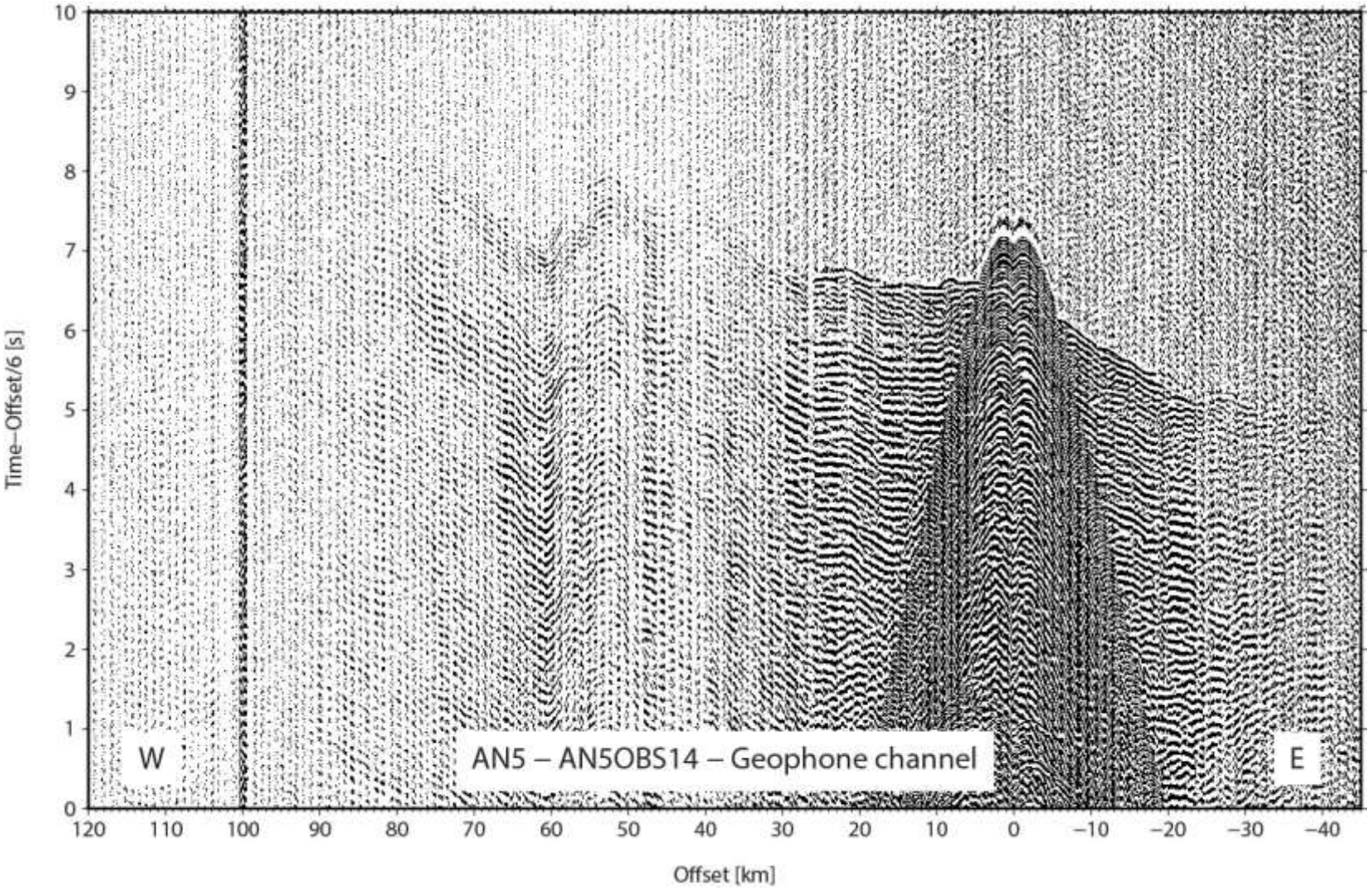

Time–Offset/6 [s]
10
9
8
7
6
5
4
3
2
1
0
W
AN5 – AN5OBS09 – Geophone channel
E
90
80
70
60
50
40
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
−80
−90
−10
Offset [km]

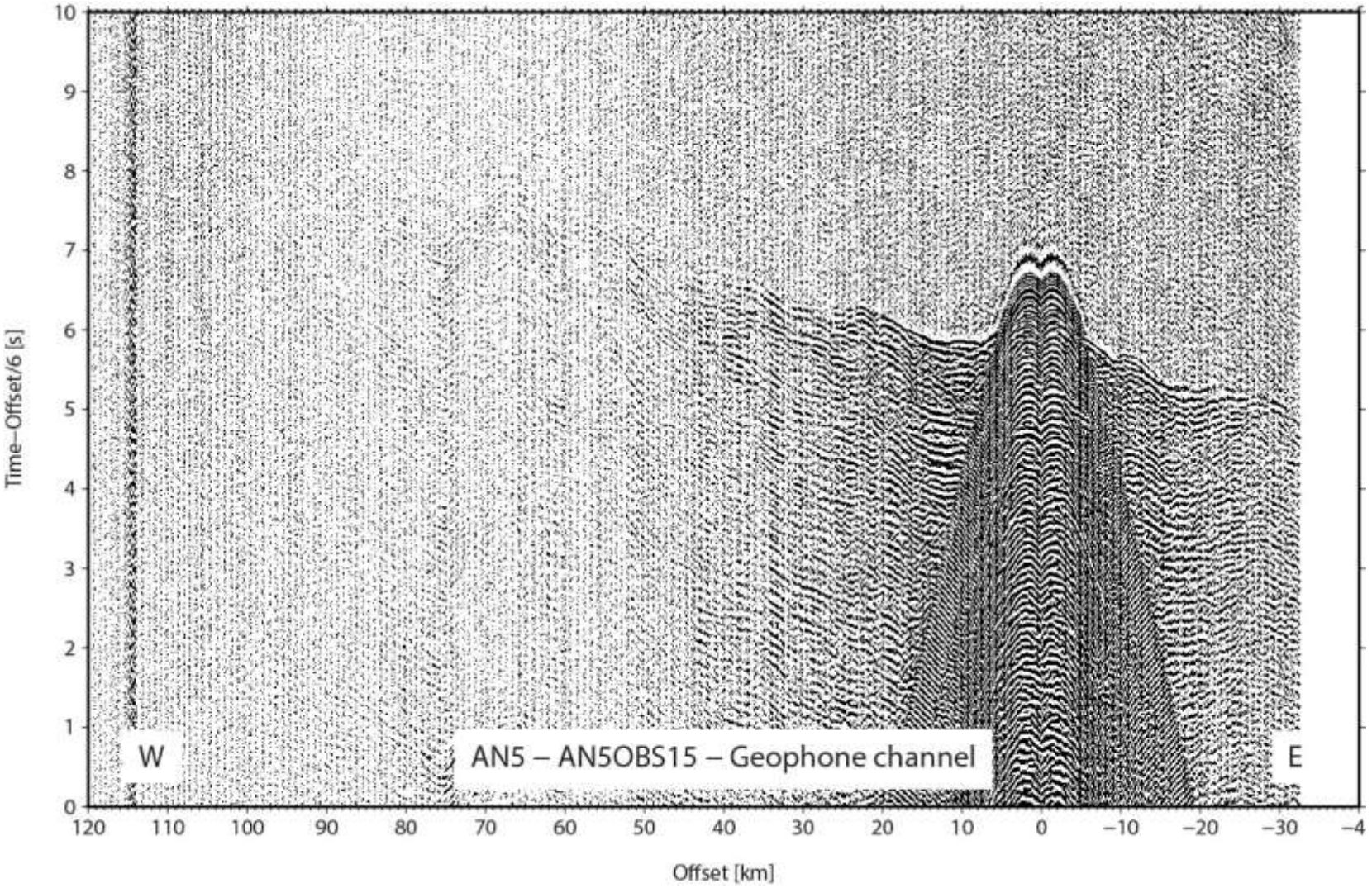

Time−Offset/6 [s]
10
9
8
7
6
5
4
3
2
1
0
W
AN5 – AN5OBS10 – Geophone channel
E
100
90
80
70
60
50
40
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
−8
Offset [km]

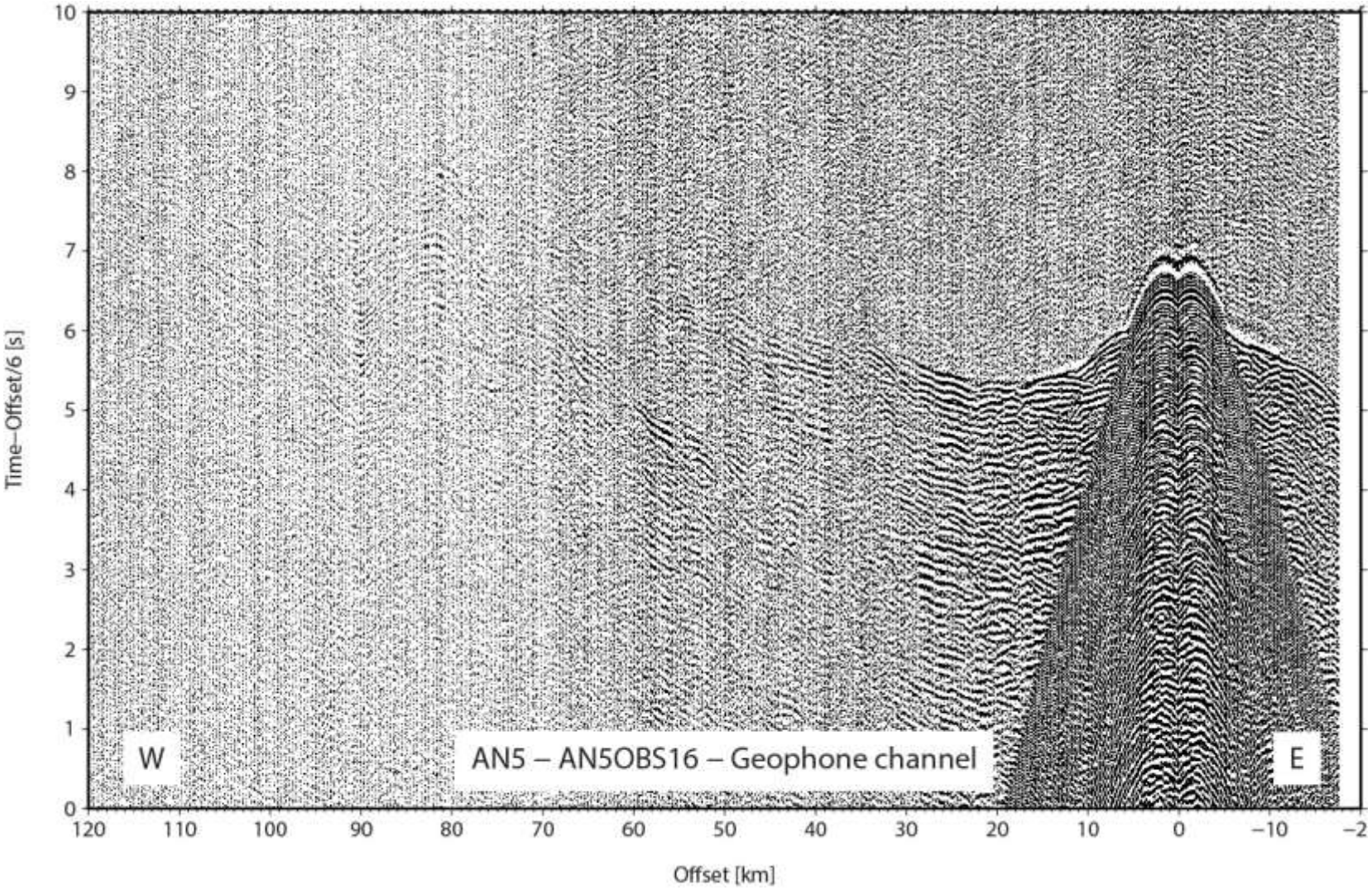

SSW
AN5 – AN5OBS11 – Geophone channel
NNE
Time–Offset/6 [s]
0
1
2
3
4
5
6
7
8
9
10
100
90
80
70
60
50
40
30
20
10
0
−10
−20
−30
−40
−50
−60
−7
Offset [km]


Time–Offset/6 [s]
10
9
8
7
6
5
4
3
2
1
0
W
AN5 – AN5OBS12 – Geophone channel
E
110
100
90
80
70
60
50
40
30
20
10
0
−10
−20
−30
−40
−50
−60
−7
Offset [km]


Time–Offset/6 [s]
10
9
8
7
6
5
4
3
2
1
0
W
AN5 – AN5OBS13 – Geophone channel
E
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
−20
−30
−40
Offset [km]


Time–Offset/6 [s]
10
9
8
7
6
5
4
3
2
1
0
W
AN5 – AN5OBS14 – Geophone channel
E
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
−20
−30
−40
Offset [km]


Time–Offset/6 [s]
10
9
8
7
6
5
4
3
2
1
0
W
AN5 – AN5OBS15 – Geophone channel
E
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
−20
−30
−4
Offset [km]


Time–Offset/6 [s]
10
9
8
7
6
5
4
3
2
1
0
W
AN5 – AN5OBS16 – Geophone channel
E
120
110
100
90
80
70
60
50
40
30
20
10
0
−10
−2
Offset [km]

Annex 2: Bathymetry map