DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE RAPPORT 2001/90

Seismic data processing of data from the NuussuaqSeis 2000 survey

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G E U S

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Seismic data processing of data from the NuussuaqSeis 2000 survey

EFP-Project NuussuaqSeis 2000:
Structure and hydrocarbon potential of the Nuussuaq Basin:
Acquisition and interpretation of high-resolution
multi-channel seismic data
ENS J.nr. 1313/99-004

Rasmus Rasmussen and
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1. Summary

Acquisition of a high-resolution seismic survey – NuussuaqSeis 2000 - took place in the second half of July 2000 in the waters around Nuussuaq and Ubekendt Ejland. The survey was designed to improve the understanding of the shallow part of the Nuussuaq basin. During the survey 2743 km of seismic data was acquired. The seismic data processing was carried out by GEUS and was initiated on board the vessel in order to ensure the data quality and to contribute to adjustments of the survey programme and was finalised back in office in the beginning of April 2001.

2. Acquisition parameters

Vessel:	R/V Dana

Source:

Line GEUS2000-01 to line GEUS2000-56, line GEUS2000-A and GEUS2000-B:

Energy source:	4 x TI SG-I sleeve guns
Airgun depth:	3.5 m
Volume:	160 cu. In
Pressure:	110 bar
SP interval:	12.5 m

Line GEUS2000-57 to line GEUS2000-66:

Energy source:	2 x TI SG-I sleeve guns
Airgun depth:	3.5 m
Volume:	80 cu. In
Pressure:	120 bar
SP interval:	12.5 m

Receiver cable:

Streamer length:	600 m
No. of groups:	96
Group interval:	3.125 m
Cable depth:	3 m
Near trace offset:	53 m

Recording:

Field recorder:	2 x Geometrics R48 units
Filter:	L.C.: 10/24(Hz, dB/Oct), H.C.: 300Hz antialiasing filter
Record length:	3072 ms
Sample interval:	1 ms
Format:	Demultiplex SEG-D 8048, revision 0

3. Testprocessing

Testing was initiated at sea on the vessel R/V Dana. Both testing and processing was carried out using PROMAX software, at sea on a standalone UNIX workstation. Test processing at sea had a dual purpose; both for QC purposes during acquisition and to initiate the processing of the data. Approximately 800 km of data was processed at sea.
The availability of a full processing system at sea was a significant factor in updating the acquisition plan as well as for QC purposes of the acquired data. In addition, valuable time back home was saved as the testing of final processing parameters was well underway already at sea.
Line GEUS00-01 is representative for the challenges in the seismic processing and was chosen as test line. Evaluation of brute stack sections from the real time RAMESSES QC system and brute stacks from the PROMAX processing suggested concentrating the seismic parameter testing to the following items:

Prestack:
1) DBS testing including removal of bubble pulse effects.
2) DMO.
3) Water bottom multiple removal.
4) Mute design.

Poststack:
1) Migration.
2) Post stack and post migration gain correction and AGC scaling.
3) Two dimensional filtering and TVF.

3.1 DBS testing

Figure 2 shows a segment of line GEUS00-01 (SP 4000-5000) only with spherical gain correction (T**2), normal move out correction and mute applied before stack. Figure 3 shows the same line segment with pre-stack deconvolution applied in addition. The deconvolution applied has a 10 ms gap and a 220 ms active operator length. Note the remarkable attenuation of bubble pulse effects resulting from the applied deconvolution. Actually details from the deconvolution parameter testing shoved the superior performance of the 220 ms active deconvolution operator covering both first and second order water bubble effects compared with operator lengths only covering first order effects. However some low frequent bubble pulse still remains in the data and will alternatively have to be removed by the Time Variant Filtering with a proper choice of low cut filter parameters (see section 3.7).

3.2 DMO

The Dip Move Out process (DMO) is normally considered to be a standard part of the processing sequence for a seismic dataset in order to remove the dip component of the stacking-velocities. The short maximum offset (650 m) used for this survey are not affecting the considerations regarding application of DMO for removal of the dip component from the stacking velocities. The DMO test is included as part of the test sequence for this survey in order to ensure that the noise attenuation accompanying the DMO process is sufficient before stack. In figure 4 DMO has been applied in addition to deconvolution before stack. Because of the improvements in signal to noise ratio after DMO no additional noise filtering before stack is considered to be necessary.

3.3 Water bottom multiple removal

Wave equation multiple removal and Radon velocity filtering has been tested in order to attenuate the water bottom multiples. The wave equation multiple removal method, however, as expected had a poor effect regarding the multiple attenuation (because of the short streamer length) and has therefore in contradiction to the Radon velocity filtering method not been included in the test panels. In figure 5 Radon velocity filtering has been applied after DMO in addition to the processing sequence applied to the data in figure 4. The water bottom multiple is substantially attenuated, but the remaining multiple energy still dominates below the first order water bottom multiple. Actually it is not possible to trace primary seismic energy below the water bottom multiple in the line segment shown in figure 5. With a few exceptions, the first water bottom multiple was found to represent the downward limitation for the seismic data all over the survey area. The Radon velocity filtering shown in figure 5 has been applied between the water bottom multiple and the bottom of the data with a short taper zone above the water bottom multiple. Especially between SP 4100 and SP 4200 primaries have been weakened in the taper zone. In conclusion it was found that remaining multiples still after the Radon velocity filtering would cause strong migration artefacts (the seismic section shown in figure 6 is a typical example of locations creating problems for the migration). Therefore and because of the downward limitations of the seismic data mentioned above, the Radon filtering has not been included in the production processing sequence for this survey. Alternatively it was decided only to migrate the data down to the first order water bottom multiple (see section 3.5).

3.4 Mute design

The line segment shown in figure 6 (line GEUS00-03, SP 4500-5500) has been selected to illustrate the rapid changes in the depth to the sea bottom which is common in the survey area. This obviously causes challenges in the mute parameter design. Manual picking of mute parameters would be very time consuming and therefore alternatively an automatic mute design based on depth measurements to the sea bottom by the echo sounder system onboard the vessel was included as part of this project. Testing of this approach was successfully and the formula for the outer trace mute throughout the survey is given by:

Mute time = water depth * 0.6 + 180 * sqrt (channel no. +35) - 1080

The water depth is in meters and the mute time is in milliseconds. In figure 7 the relation between gun-receiver offsets and mute times is shown for different water depths. The dark blue curve intersecting the other curves represent the relation between sea bottom depth (measured in ms) and the maximum offsets included in the stacking process at the sea bottom. For relatively shallow water depths the mute is relatively strong reflecting the complex sea bottom topography so typical for these parts of the survey area (scars etc. - the section shown in figure 6 is a typical example).

3.5 Migration testing

The brute stack sections of line GEUS00-01 and GEUS00-03 together with the test results from the multiple attenuation (see section 3.3) demonstrated the difficulties in getting around migration artefacts caused by the strong first order water bottom multiple. Furthermore inspection of the stacked sections from the Ramesses online processing system and a substantial amount of brute stack data from the ProMax processing system showed with a few exceptions no possibilities for detecting primary events below the water bottom multiple. Exclusion of data from the water bottom multiple and downwards before migration was therefore considered to be the best compromise in getting around artefacts caused by remaining water bottom multiples. FK migration, finite difference migration and Kirchoff migration were tested. The Kirchoff migration algorithm was chosen for migration of the data from this survey because of superior performance regarding data quality in general and especially in areas with extreme surface topography and complicated geological structures compared to the other tested migration algorithms. In figure 8 the migrated section of line GEUS00-32 SP 200-1200 is shown. Small artefacts ('smiles') caused by remnants of the first order water bottom multiple are seen in the lower part of the data around one of the scars (around SP 700). Apart from this the migration result even in relatively complicated areas as shown in this example is considered to be very satisfactory. The 'smile’ problem could be further reduced by supplementary manual mute in areas with remnants of the water bottom multiple. However, the remaining problems after the purely water depth based mute are not believed to create any problems in the interpretation of the data.

3.6 Post stack and post migration gain correction and AGC scaling

The section 3.1 to section 3.4 the prestack processing parameters has been discussed and the final prestack sequence has been applied to the data shown in figure 4. In figure 9 the same line segment is shown without any poststack processing applied at all. Obviously further gain correction in addition to the T**2 gain correction applied up front in the prestack processing is absolutely necessary. The amplitudes of the first order water bottom multiple is typically an order of magnitude larger than the amplitudes of the primary events immediately above and only in a few exceptional cases primaries can be tracked below the water bottom multiple. Therefore a combination of additional gain correction and AGC downscaling of the seismic section from the first order water bottom multiple was chosen as the first step in getting a properly balanced seismic section. The parameters for the gain correction is given by T**1.5 (after water bottom dependant horizon flattening) and the supplementary AGC scaling (robust type) from the first order water bottom multiple has a 250 ms window length. These processing parameters have been applied to the data immediately after stack and the result is shown in figure 10. Note the substantial improvements regarding gain corrections. However additional AGC scaling is necessary in order to improve the appearance of weak reflections. A combination of different window lengths (60 ms, 125 ms, 200 ms, 350 ms and 600 ms) was used for the AGC scaling (robust type) in order to obtain a properly balanced section without getting shadow zones around the strong reflectors. Before the AGC scaling a weak supplementary gain correction (T**0.3 for the stack sections and T**0.5 for the migrated sections - both applied after water bottom dependant horizon flattening) were applied. After the AGC scaling a trace balancing AGC (robust type, window length 2000 ms) was applied. In figure 11 the final result of the gain and AGC corrected stack section is shown. Similarly the migrated stacks are shown in figure 8 and 14 (DIPSCAN filtering and TVF have been applied in addition to these migrated stack examples). In conclusion these parameters were found to give a proper balance between standout of strong events and visibility of weak events.
Lessons learned from this part of the testing are the importance of a stepwise approach for the gain correction. The composite gain correction applied is considered to meet the requirements encountered in this survey, but based on the experience from this project and other projects a 2-step gain correction based on the following principles would undoubtedly have been easier:

1) Proper gain correction at sea level and partial gain correction downwards (T**1 correction)
2) Appropriate, additional gain correction downwards from the sea bottom

3.7 Two dimensional filtering and TVF

Finally noise filtering using Time Variant Filtering (TVF) and two-dimensional filtering methods together with low cut filtering for bubble pulse attenuation will be discussed. The small CDP distance (3.125 m) has been considered to be very advantageous for applying two-dimensional filtering techniques as part of the noise reduction methods. The stack section after applying the DIPSCAN routine (enhancing coherent dips inside specified dip limitations - for this survey +/- 4 ms/trace (representing dips up to about 45 degrees) has been used as limitation) is shown in figure 12 as the first step in noise attenuation after stack. Compared to figure 11 (same section without application of DIPSCAN) the signal to noise ratio has been improved resulting in enhanced interpretability of the seismic section. Finally the stack section after applying a standard TVF with relatively high low cut filter parameters (taper zone between 19 and 25 Hz) for improved bubble pulse attenuation is shown in figure 13. Similarly examples of final migrated stack are shown in figure 8 and 14. Everywhere the bubble pulse has almost been removed completely.

3.8 Final processing flow

SEG-D read to final stack:

1. Tape read, noise editing and trace binning (3.125 m CDP distance)
2. Spherical gain correction T**2
3. Resampling from 1 to 2 ms
4. DBS, gap 10 ms, operator length 220 ms, one operator (10/220-1)
5. DMO (Dip Move Out, FK method, 25 m dmo-offset bins)
6. Velocity analyses, every 2km
7. NMO and trace mute
8. CDP-stack
9. AGC scaling, applied from first order water bottom multiple (robust type, 250 ms windows)
10. Gain correction (T**1.5, applied after water bottom dependant horizon flattening)
11. DIPSCAN (+/- 4 ms/trace, weak TVF applied (from 16-22 to 180-220 Hz at the sea bottom, from 16-22 to 70-90 Hz at the bottom of the data set) in front of the DIPSCAN process)
12. Gain correction (T**0.3 ,applied after water bottom dependant horizon flattening)
13. AGC scaling (multiple times, window length: 60, 125, 200,350 and 600 ms, robust type)
14. Trace balancing (robust AGC type, window lengths 2000 ms)
15. TVF (from 19-25 to 180-220 Hz at the sea bottom, from 19-25 to 60-80 Hz at the bottom of the data set)
16. Display and transfer to interpretation

SEG-D read to final migrated stack:

1. Tape read, noise editing and trace binning (3.125 m CDP distance)
2. Spherical gain correction T**2

3. Resampling from 1 to 2 ms
4. DBS, gap 10 ms, operator length 220 ms, one operator (10/220-1)
5. DMO (Dip Move Out, FK method, 25 m dmo-offset bins)
6. Velocity analyses, every 2km
7. NMO and trace mute
8. CDP-stack
9. AGC scaling, applied from first order water bottom multiple (robust type, 250 ms windows)
10. Gain correction (T**1.5, applied after water bottom dependant horizon flattening)
11. Kirchoff time migration
12. DIPSCAN (+/- 4 ms/trace, weak TVF applied (from 16-22 to 180-220 Hz at the sea bottom, from 16-22 to 70-90 Hz at the bottom of the data set) in front of the DIPSCAN process)
13. Gain correction (T**0.5 applied after water bottom dependant horizon flattening)
14. AGC scaling (multiple times, window length: 60, 125, 200,350 and 600 ms, robust type)
15. Trace balancing (robust AGC type, window lengths 2000 ms)
16. TVF (from 19-25 to 180-220 Hz at the sea bottom, from 19-25 to 60-80 Hz at the bottom of the data set)
17. Display and transfer to interpretation

4. Conclusion

The NuussuaqSeis 2000 survey acquired in the waters around Nuussuaq and Ubekendt Ejland covers areas very different in seismic response. The data can be categorised into three different types of geology:

1) South of Nuussuaq (Vaigat area) and north of Nuussuaq/West of Uummannaq Fjord mainly covering sedimentary basins. Complicated sea bottom topography for example caused by landslides, Ice age effects and sills is very common.
2) The northern part of the survey area South of the Svartenhuk Halvø and east of Ubekendt Ejland. The depth to basement is shallow.
3) The area west of Nuussuaq and Ubekendt Ejland is dominated by basalt.

Despite the differences between different parts of the survey area one single processing flow was established to cover the whole survey area. The largest challenges during testing of the data from this survey have been:

1) To investigate the possibility to identify primary seismic information below the first order water bottom multiple.
2) To obtain a proper gain correction and AGC scaling compromising between relative true amplitude and sufficient standout of weak events.
3) To implement the automatic outer trace mute based on trace offset and sea bottom depth recordings.

The relatively small source array (total array size 160 cu. in.) and the 600 m streamer length indicated beforehand that the first water bottom multiple constitutes the lower limitation of the target zone for this survey. With a few exceptions it is not possible to trace primary events below the water bottom multiple. As a consequence of this and because of the limitations in the efficiency of the tested multiple removal tools the natural compromise has been to process the final stack to full trace length whereas the final migration processing has been limited downwards by the water bottom multiple.
The overall impression after the processing have been finalised is, that the data quality is very good. It is anticipated that the interpretation of the data from this survey will contribute considerable to the understanding of the geology in the area.

5. Figures

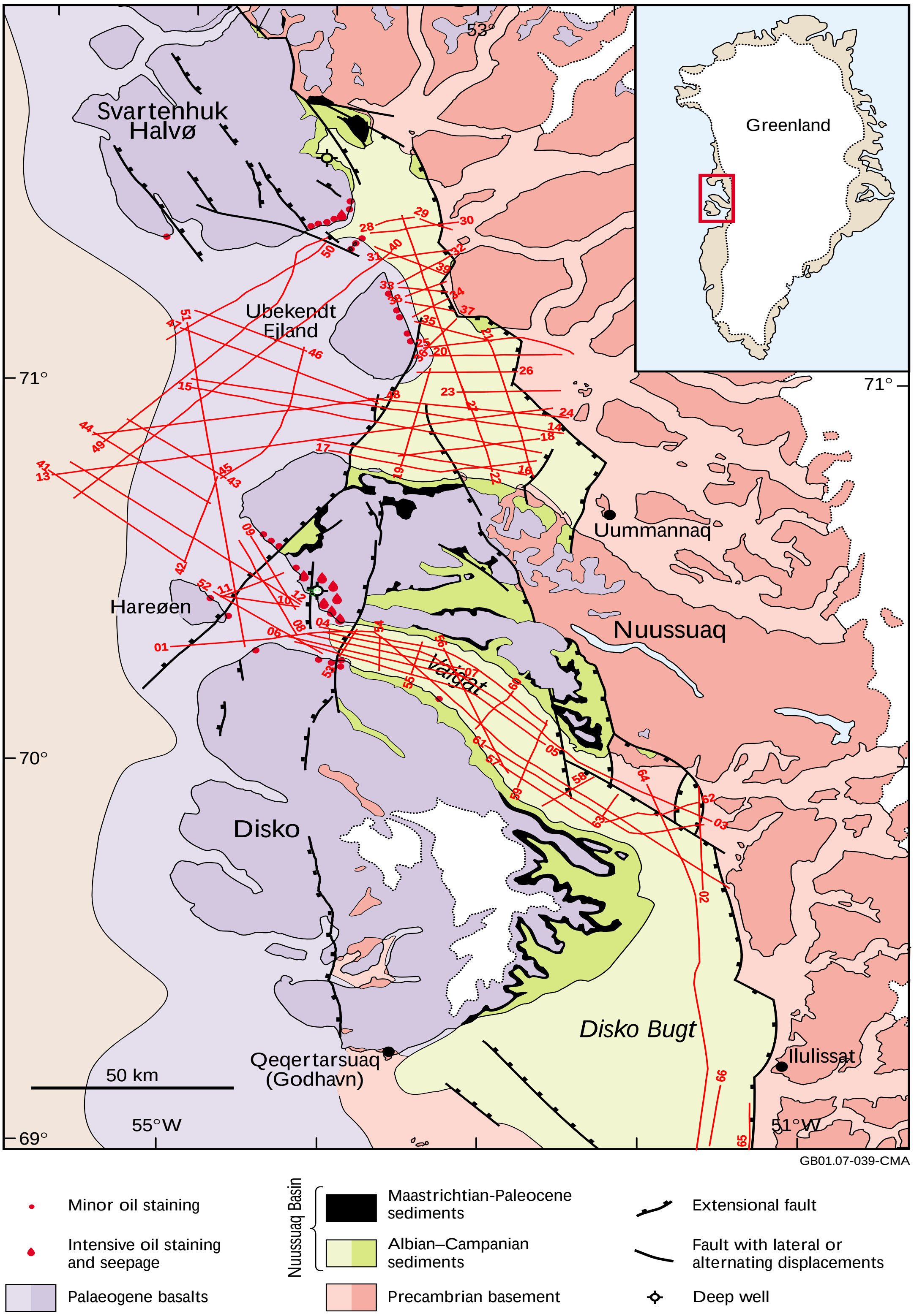

Fig. 1: Seismic lines acquired during the NuussuaqSeis 2000 survey are shown in red. All line names have the prefix GEUS00-. Line numbers placed at start of line.

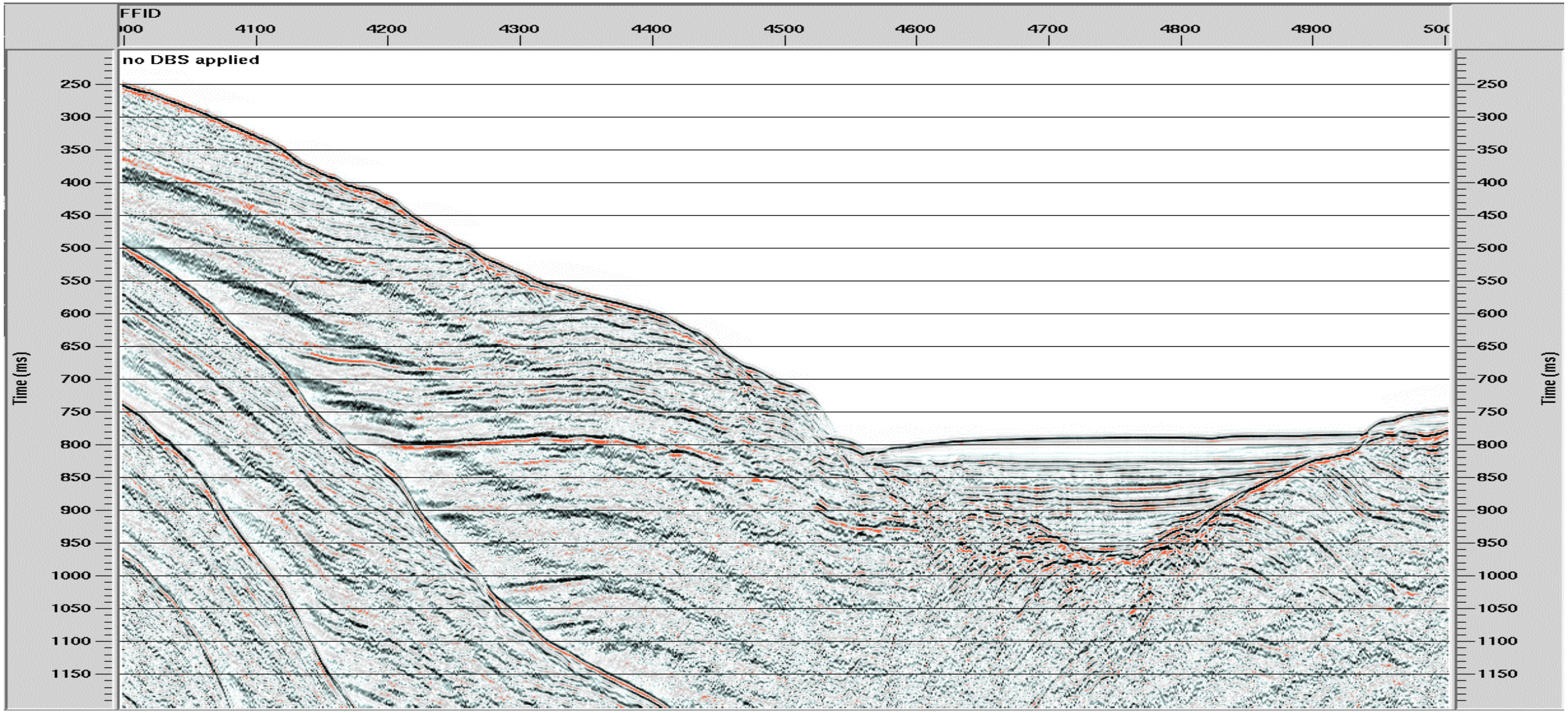

Fig. 2: Stack display of line GEUS00-01, SP 4000-5000. Spherical gain correction has been applied before stack, additional gain correction and AGC scaling has been applied after stack.

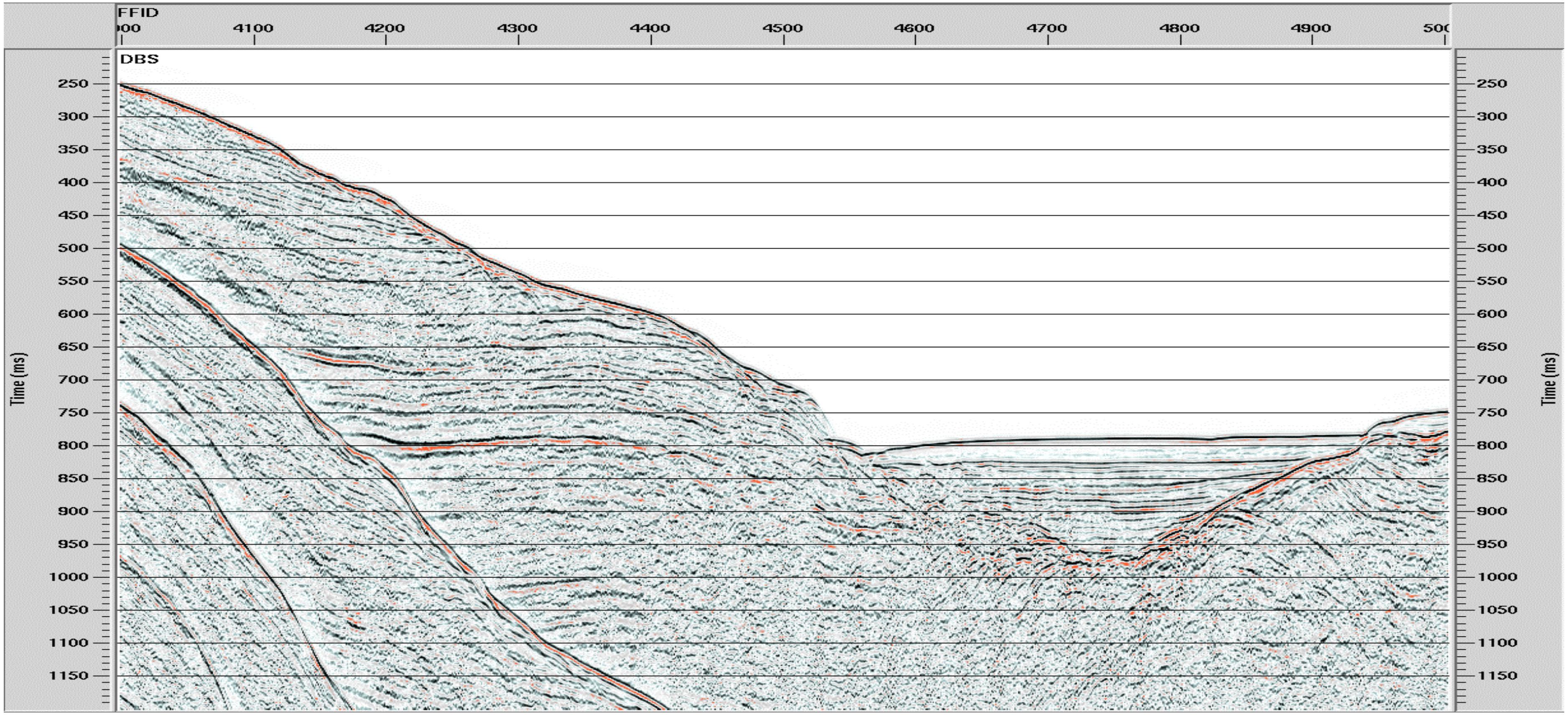

Fig.3: Stack display of line GEUS00-01, SP 4000-5000. Spherical gain correction and DBS 10/220-1 has been applied before stack, additional gain correction and AGC scaling has been applied after stack.

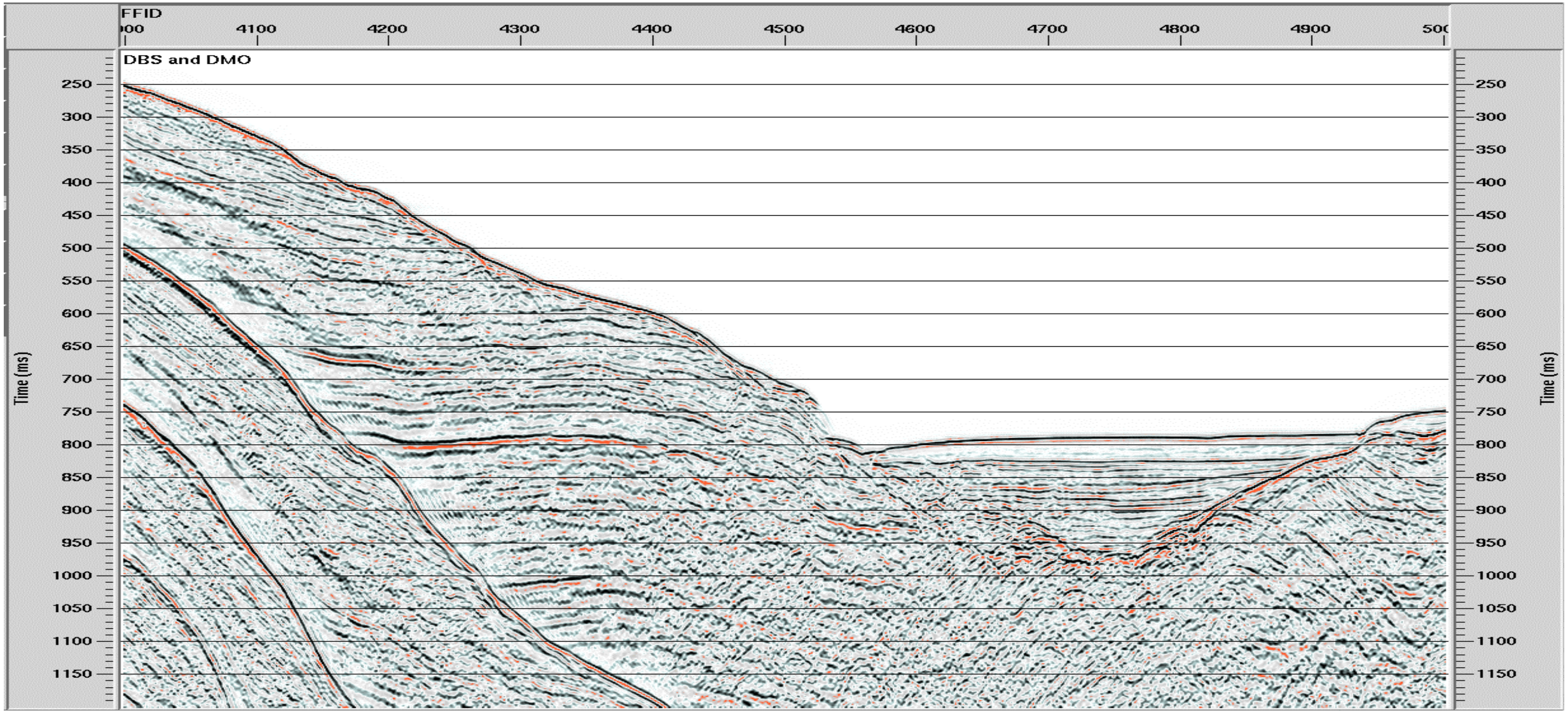

Fig.4: Stack display of line GEUS00-01, SP 4000-5000. Spherical gain correction, DBS 10/220-1 and DMO has been applied before stack, additional gain correction and AGC scaling has been applied after stack.

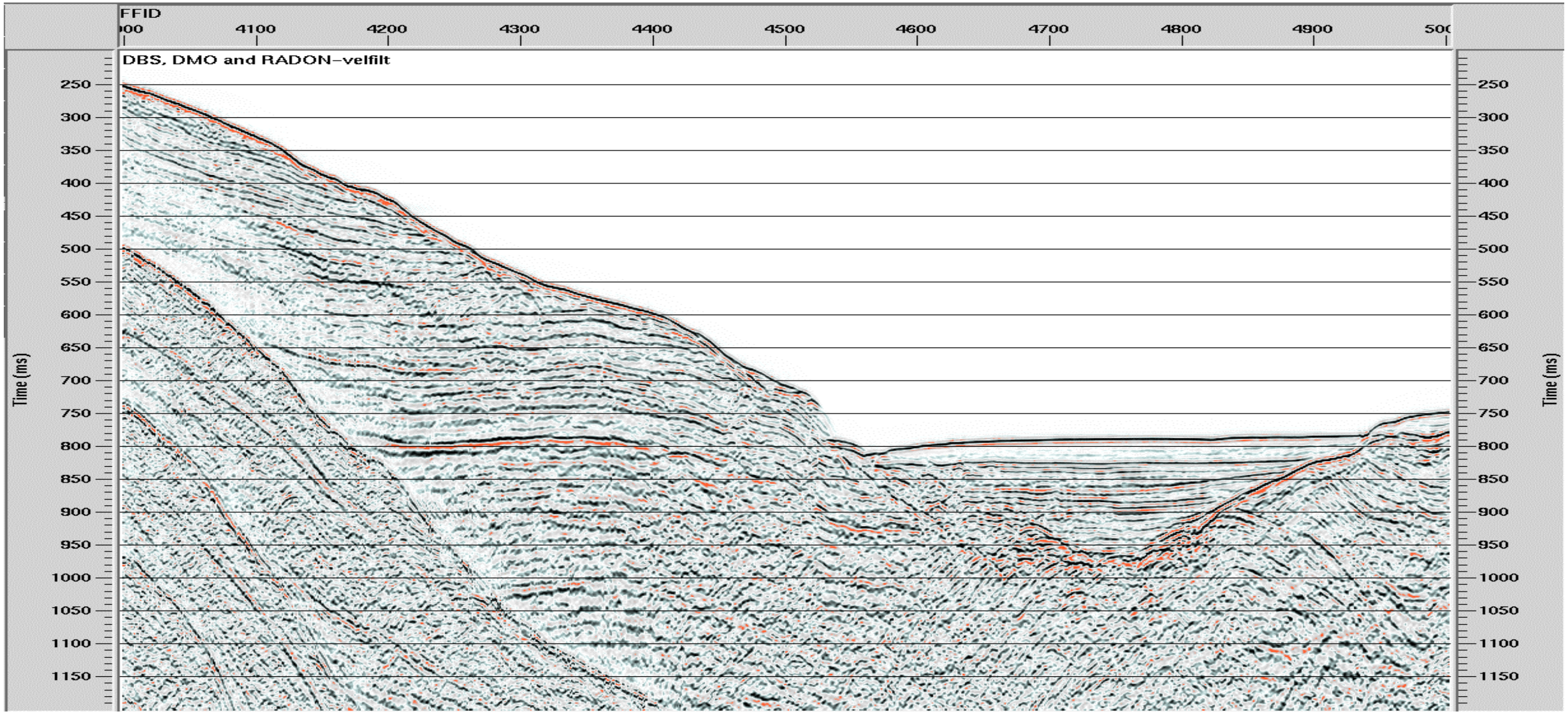

Fig.5: Stack display of line GEUS00-01, SP 4000-5000. Spherical gain correction, DBS 10/220-1, DMO and RADON velocity filtering has been applied before stack, additional gain correction and AGC scaling has been applied after stack.

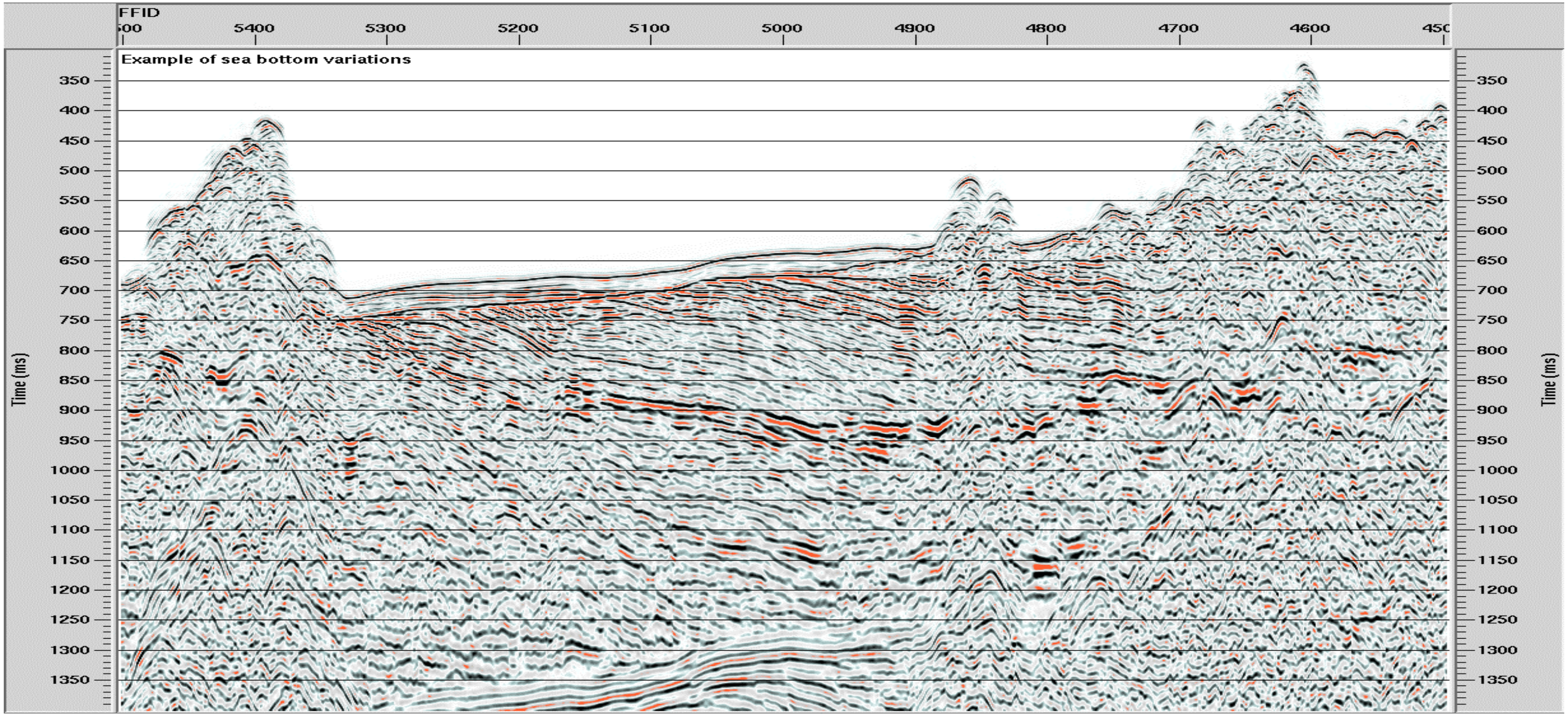

Fig. 6: Final stack display of line GEUS00-03, SP 4500-5500 (processing parameters - see section 3.8). This line segment visualises the needs for automatic mute design based on sea bottom depth recordings.

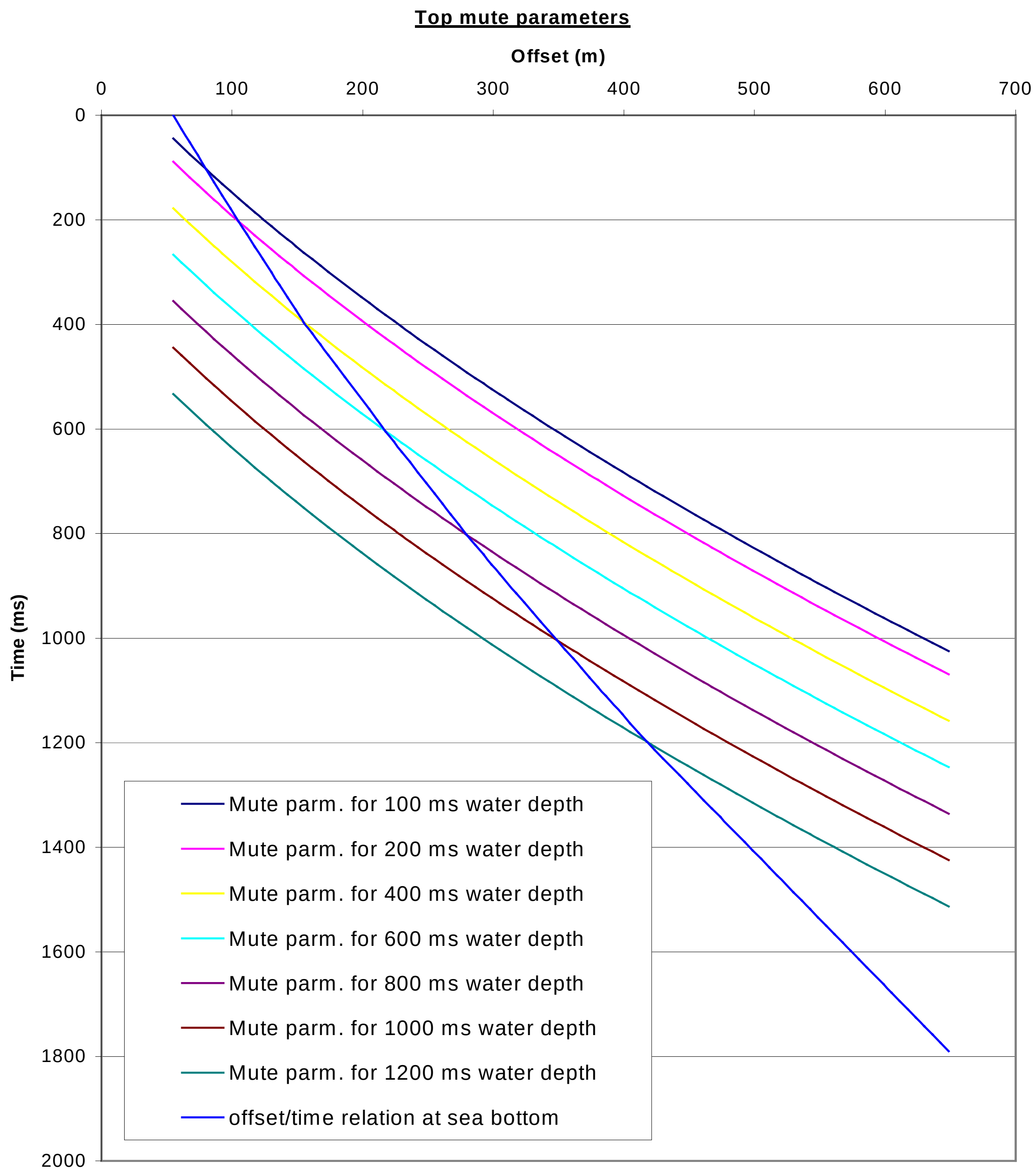

Fig. 7: Offset-time relation for top mute applied before stack for different water depths. The dark blue curve intersecting the other curves represent the relation between sea bottom depth (measured in ms) and the maximum offsets included in the stacking process at the sea bottom.

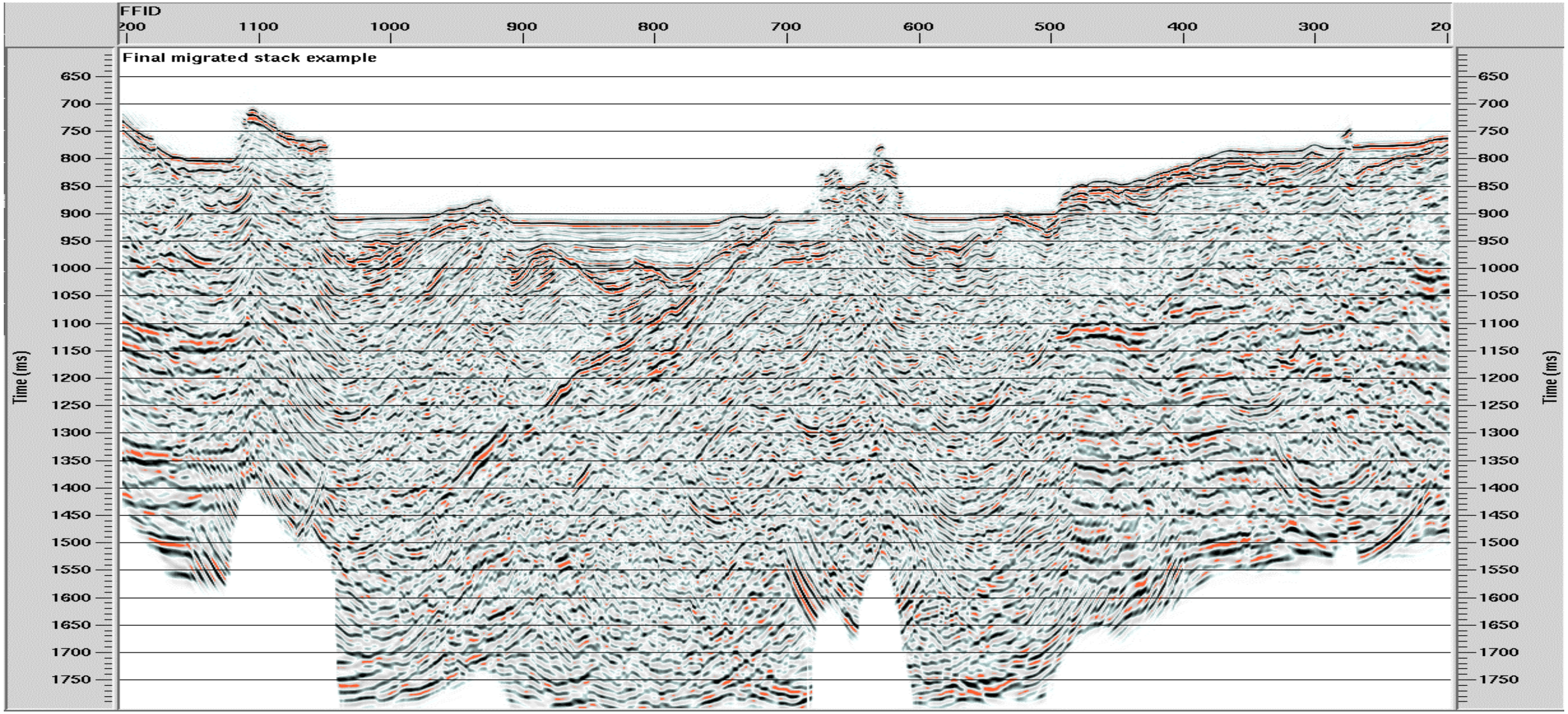

Fig. 8: Final migrated stack display of line GEUS00-32, SP 200-1200 (processing parameters - see section 3.8). The results from using the Kirchoff time migration algorithm are very good even in areas like this where the surface topography is very rough and the geology beneath are relatively complicated. Note also the relatively small migration artefacts ('smiles') caused by remnants of the first sea bottom multiple after mute of data beneath.

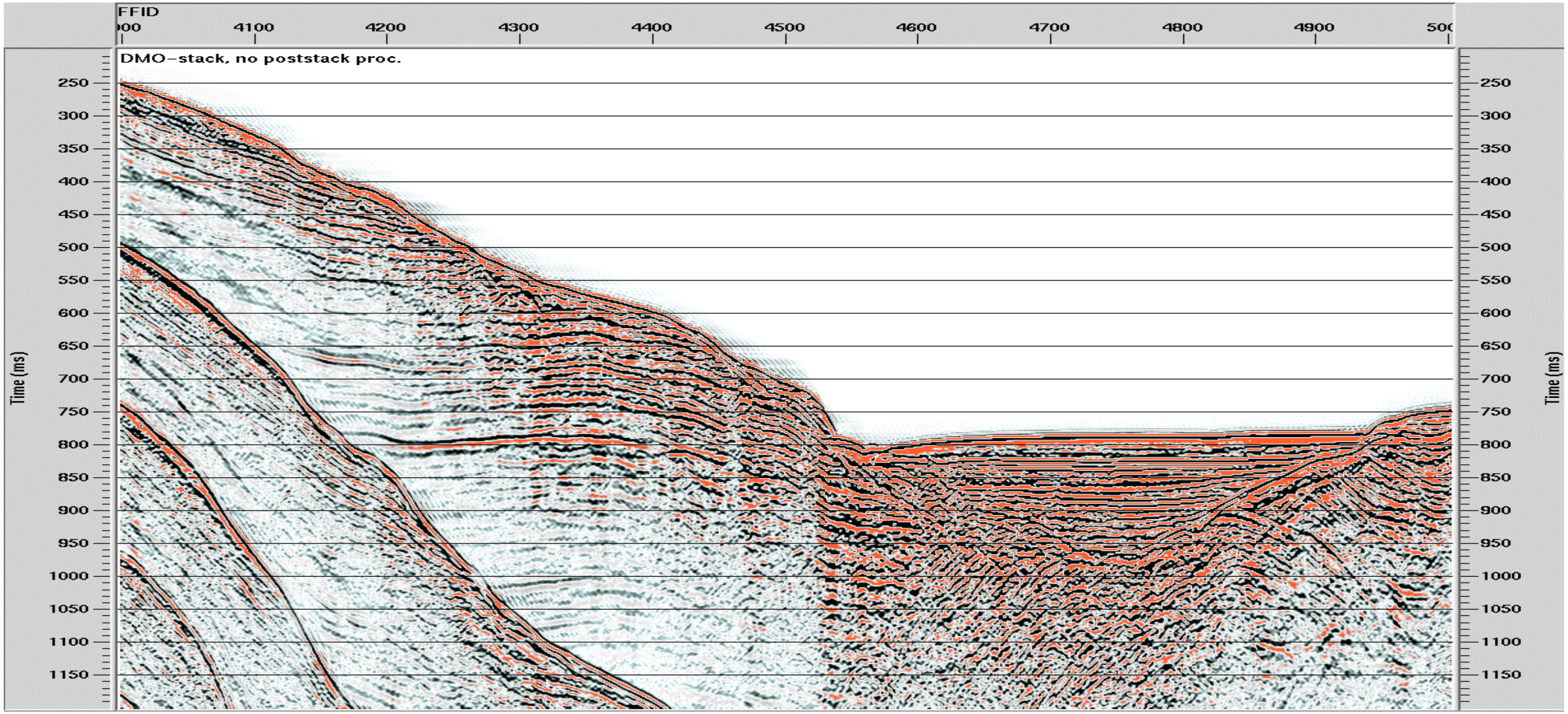

Fig. 9: Stack display of line GEUS00-03, SP 4500-5500. Spherical gain correction, DBS 10/220-1 and DMO are applied before stack, no processing after stack. Additional gain correction in addition to the T**2 gain correction applied before stack combined with AGC scaling is necessary.

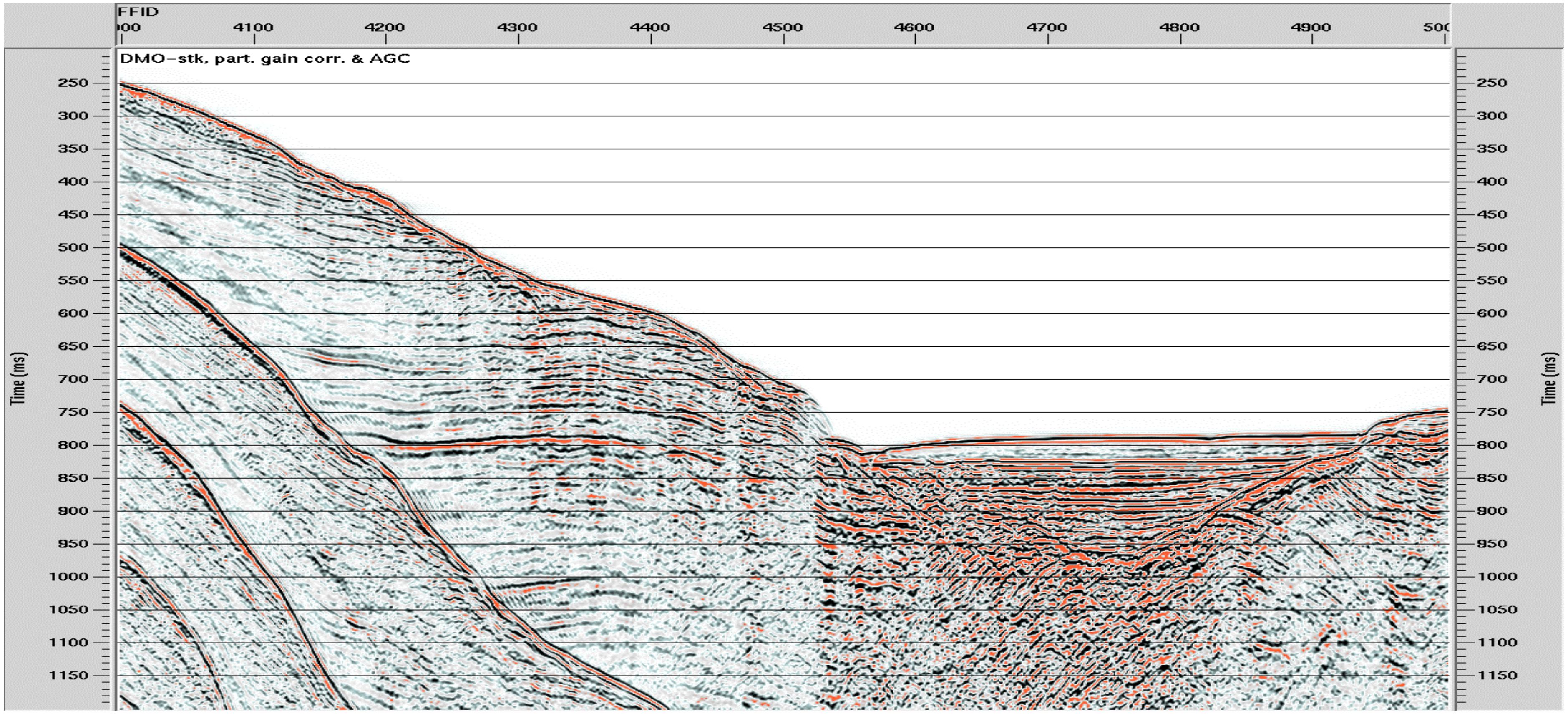

Fig. 10: Stack display of line GEUS00-03, SP 4500-5500. Gain correction (T**1.5) and AGC scaling below the water bottom multiple is applied after stack in addition to the processing applied to the test shown in figure 9.

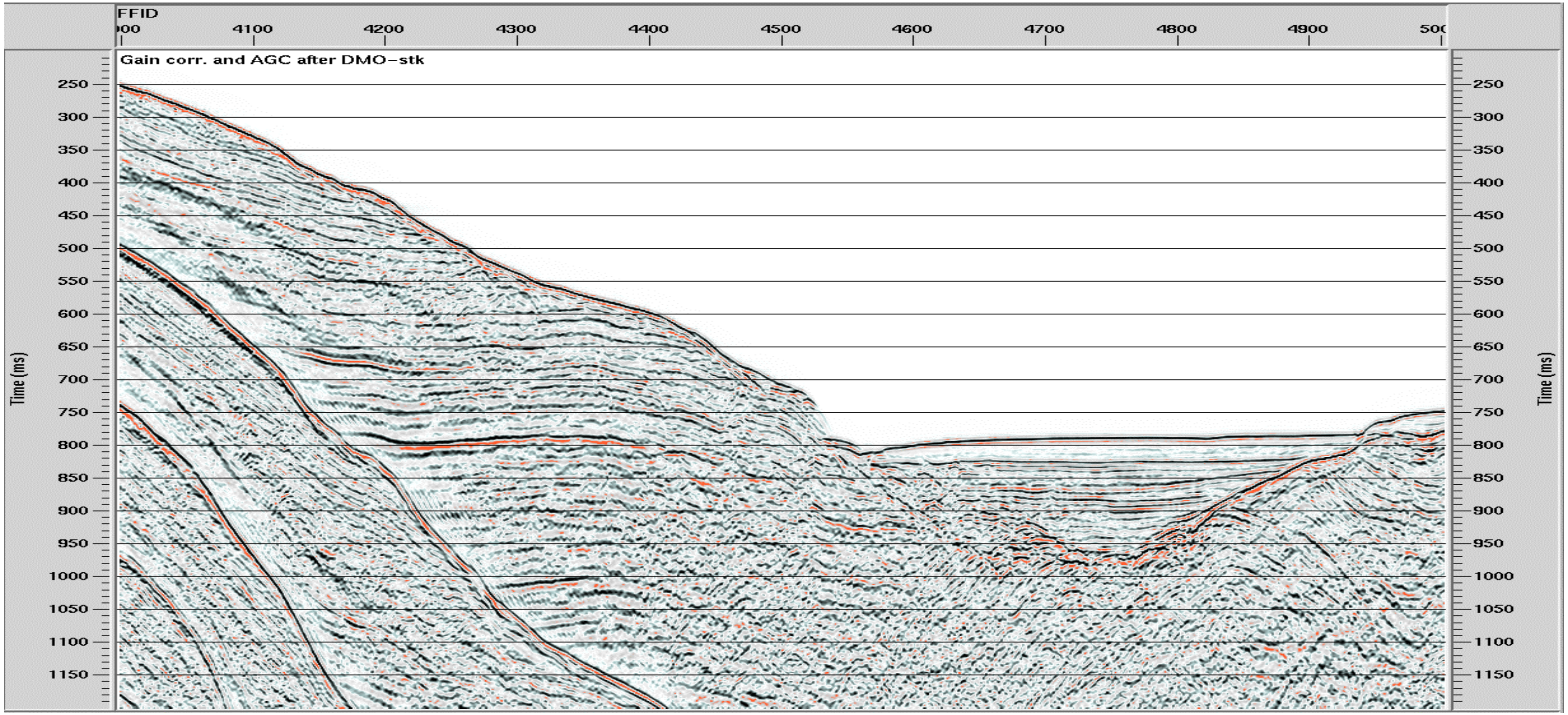

Fig. 11: Stack display of line GEUS00-03, SP 4500-5500. Additional gain correction (T**0.3) and multiple AGC scaling (window lengths 60-2000 ms, robust AGC type) applied in addition to the parameters applied for the seismic section shown in figure 10.

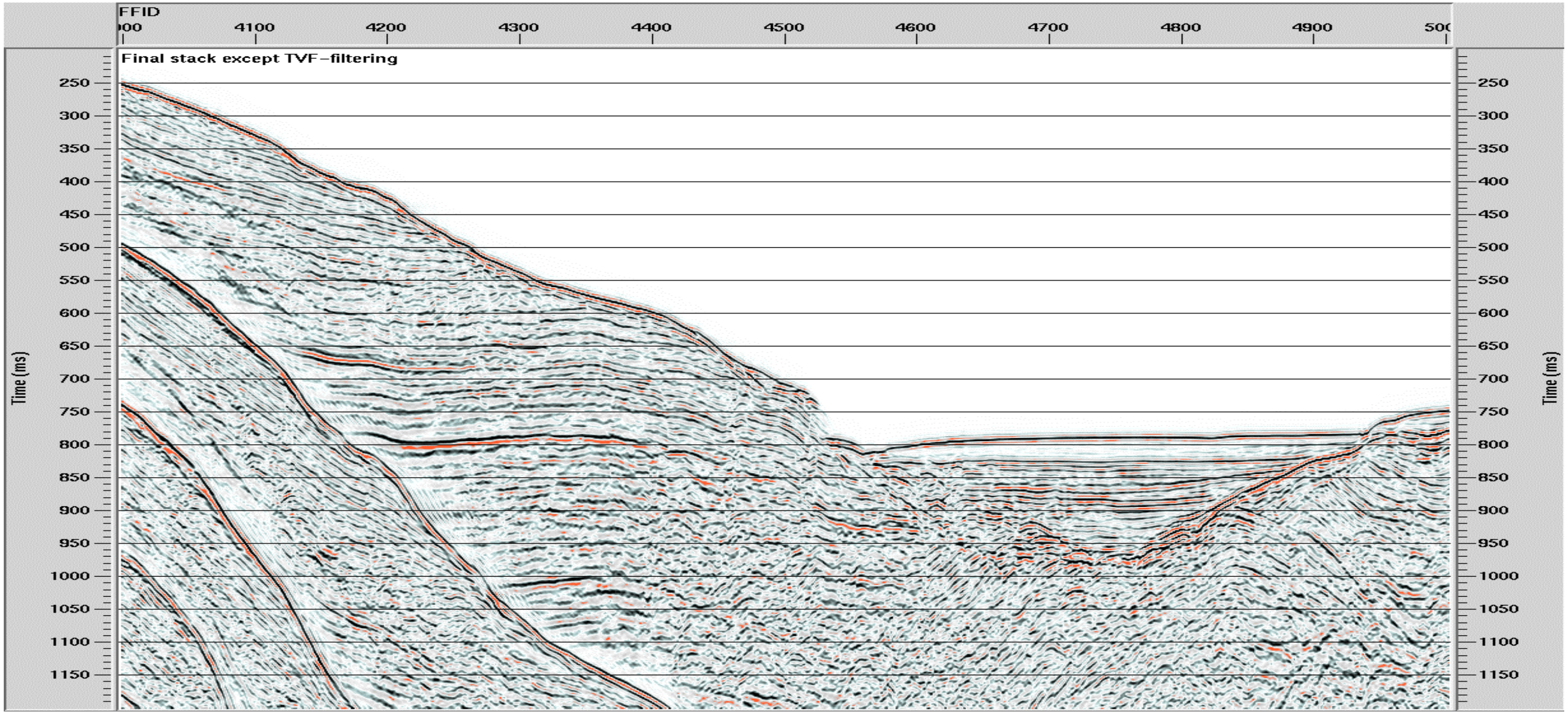

Fig. 12: Stack display of line GEUS00-03, SP 4500-5500. DIPSCAN filtering has been applied in addition to the parameters applied for the seismic section shown in figure 11.

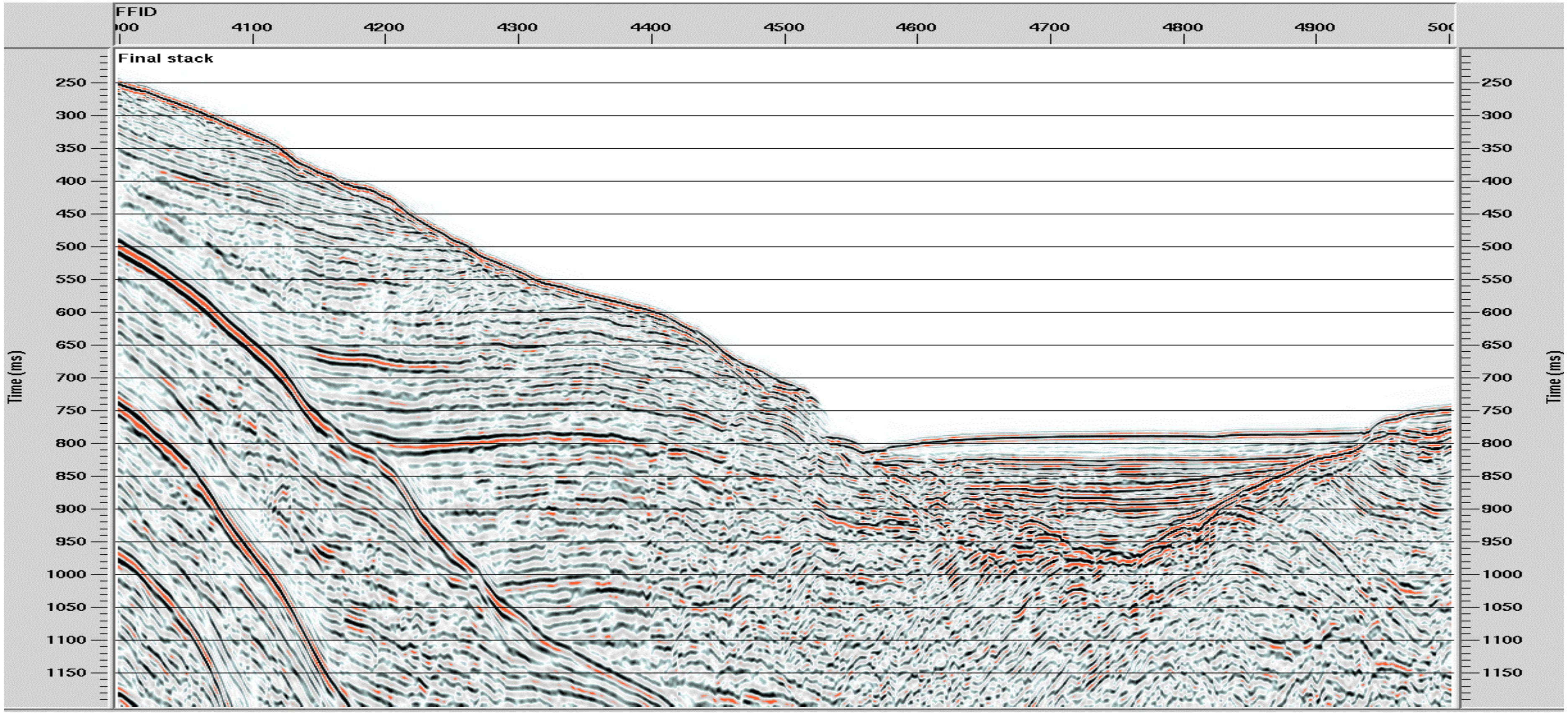

Fig. 13: Final stack display of line GEUS00-03, SP 4500-5500. Compared to figure 12 TVF filtering has been applied in addition. Complete list of processing parameters is listed in section 3.8.

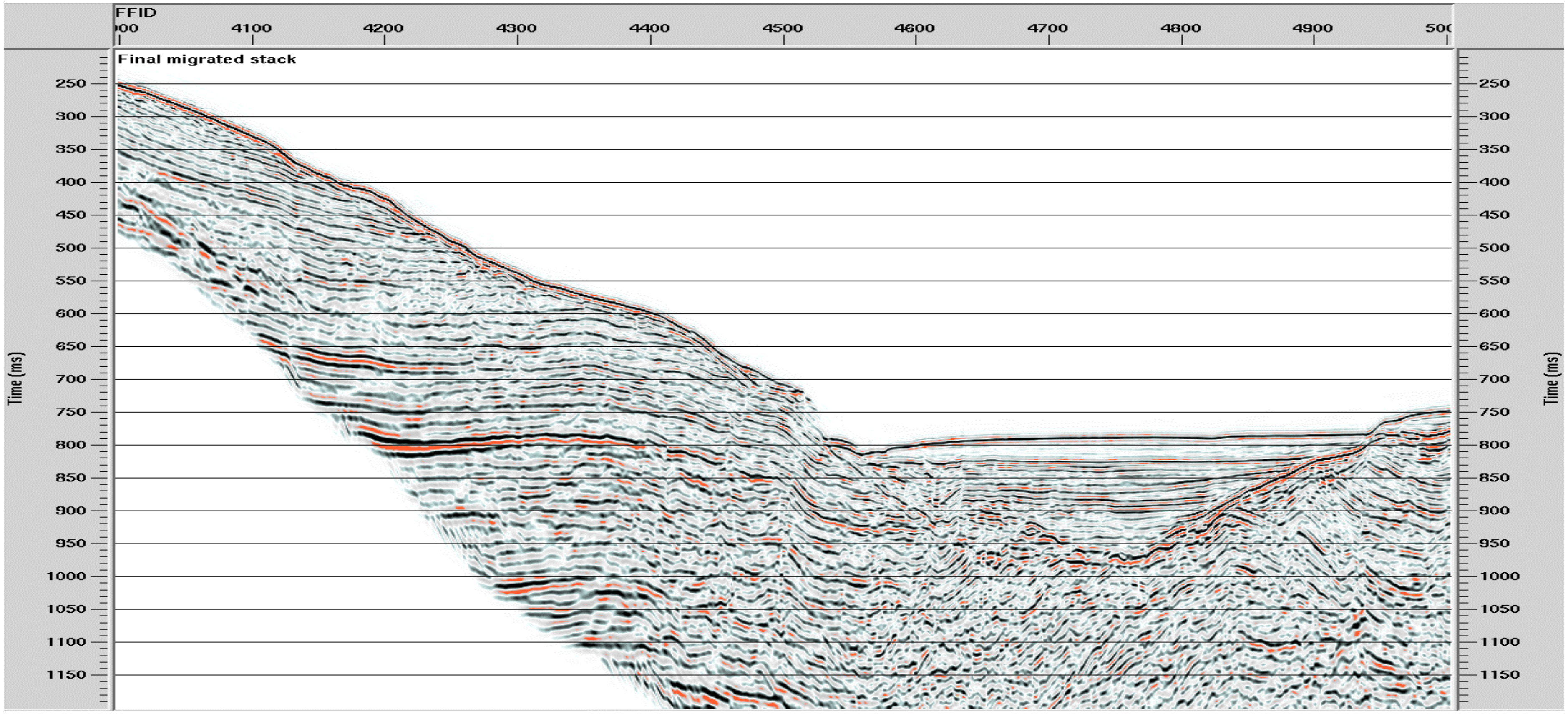

Fig. 14: Final migrated stack display of line GEUS00-03, SP 4500-5500. Complete list of processing parameters is listed in section 3.8.

6. Line list, NuussuaqSeis 2000 survey.

Line no.	SP min	SP max	FFID min	FFID max	SP ident field min	SP ident field max	Min CDP	Max CDP	SP ident proc min	SP ident proc max	Seiswork min trace	Seiswork max trace	Seiswork trace - SP 1 relation	Lost SP idents, field numbering	Lost SP idents, proc numbering
GEUS00-01	1	13274	1	13269	1	13274	896	54083	1	13274	944	27537	991	2,9613,11135-11137	2,9613,11135-11137
GEUS00-02	1	2419	1	2419	7	2425	896	10663	1	2419	944	5827	991		
GEUS00-03	1	8960	1	8957	1	8960	896	36827	1	8960	944	18909	991	2,9,8256	2,9,8256
GEUS00-04	1	5140	1	5136	1	5140	896	21547	1	5140	944	11269	991	2,678-680	2,678-680
GEUS00-05	1	5476	1	5458	3	5478	896	22891	1	5476	944	11941	991	* see below	** see below
GEUS00-06	1	3837	1	3836	2	3838	896	16335	1	3837	944	8663	991	266	265
GEUS00-07	1	3220	1	3220	1	3221	896	13867	1	3220	944	7429	991	2	
GEUS00-08	1	2492	1	2492	1	2493	896	10955	1	2492	944	5973	991	2	
GEUS00-09	1	1930	1	1930	1	1931	896	8707	1	1930	944	4849	991	2	
GEUS00-10	1	1595	1	1595	1943	3537	896	7367	1	1595	944	4179	991		
GEUS00-11	1	1350	1	1350	3552	4901	896	6387	1	1350	944	3689	991		
GEUS00-12	1	5576	1	5576	1	5578	896	23291	1	5577	944	12141	991	2,57	56
GEUS00-13	1	9939	1	9939	1	9942	896	40743	1	9941	944	20867	991	2,3885,7083	3884,7082
GEUS00-14	1	7450	1	7450	1	7453	896	30787	1	7452	944	15889	991	2,1189,1252	1188,1251
GEUS00-15	1	7080	1	7079	1	7080	896	29307	1	7080	944	15149	991	2	2
GEUS00-16	1	4252	1	4252	14	4265	896	17995	1	4252	944	9493	991		
GEUS00-17	1	4182	1	4182	1	4183	896	17715	1	4182	944	9353	991	2	
GEUS00-18	1	2834	1	2834	1	3836	896	12323	1	2835	944	6657	991	2,1383	1382
GEUS00-19	1	2393	1	2393	1	2394	896	10559	1	2393	944	5775	991	2	
GEUS00-20	1	2636	1	2636	18	2653	896	11531	1	2636	944	6261	991		
GEUS00-21	1	3333	1	3331	1	3333	896	14319	1	3333	944	7655	991	2,1575	2,1575
GEUS00-22	1	2109	1	2109	1	2110	896	9423	1	2109	944	5207	991	2	
GEUS00-23	1	2052	1	2052	1	2053	896	9195	1	2052	944	5093	991	2	
GEUS00-24	1	3984	1	3984	1	3985	896	16923	1	3984	944	8957	991	2	

GEUS00-25	1	3109	1	3109	1	3110	896	13423	1	3109	944	7207	991	2	
GEUS00-26	1	1997	1	1997	1	1998	896	8975	1	1997	944	4983	991	2	
GEUS00-27	1	4508	1	4508	1	4510	896	19019	1	4509	944	10005	991	2,3193	3192
GEUS00-28	1	839	1	839	4512	5350	896	4343	1	839	944	2667	991		
GEUS00-29	1	689	1	689	1	690	896	3743	1	689	944	2367	991	2	
GEUS00-30	1	1798	1	1798	692	2490	896	8179	1	1798	944	4585	991	693	
GEUS00-31	1	1277	1	1277	1	1278	896	6095	1	1277	944	3543	991	2	
GEUS00-32	1	1293	1	1293	1	1294	896	6159	1	1293	944	3575	991	2	
GEUS00-33	1	983	1	983	1	983	896	4919	1	983	944	2955	991		
GEUS00-34	1	856	1	856	1	857	896	4411	1	856	944	2701	991	2	
GEUS00-35	1	1627	1	1627	1	1628	896	7495	1	1627	944	4243	991	2	
GEUS00-36	1	1030	1	1030	1	1031	896	5107	1	1030	944	3049	991	2	
GEUS00-37	1	1011	1	1011	4	1014	896	5031	1	1011	944	3011	991		
GEUS00-38	1	897	1	897	3	899	896	4575	1	897	944	2783	991		
GEUS00-39	1	1581	1	1581	1	1582	896	7311	1	1581	944	4151	991	2	
GEUS00-40	1	8559	1	8558	1	8559	896	35223	1	8559	944	18107	991	2	2
GEUS00-41	1	3462	1	3461	1	3463	896	14835	1	3462	944	7913	991	2,1638	1637
GEUS00-42	1	2122	1	2122	3465	5587	896	9475	1	2122	944	5233	991	3466	
GEUS00-43	1	2382	1	2380	1	2383	896	10515	1	2382	944	5753	991	2,459,1115	
GEUS00-44	1	2834	1	2834	2385	5219	896	12323	1	2834	944	6657	991	2	
GEUS00-45	1	3927	1	3927	5221	9148	896	16695	1	3927	944	8843	991	2	
GEUS00-46	1	2396	1	2396	1	2397	896	10571	1	2396	944	5781	991	2	
GEUS00-47	1	4254	1	4254	1	4254	896	18003	1	4254	944	9497	991		
GEUS00-48	1	5749	1	5749	1	5750	896	23983	1	5749	944	12487	991	2	
GEUS00-49	1	6716	1	6716	1	6717	896	27851	1	6717	944	14421	991	5619	5619
GEUS00-50	1	3935	1	3934	1	3936	896	16727	1	3935	944	8859	991	2,2615	2614
GEUS00-51	1	7601	1	7601	1	7602	896	31391	1	7601	944	16191	991	2	
GEUS00-52	1	2595	1	2595	1	2596	896	11367	1	2595	944	6179	991	2	
GEUS00-53	1	734	1	734	1	735	896	3923	1	734	944	2457	991	2	
GEUS00-54	1	812	1	812	1	813	896	4235	1	812	944	2613	991	2	
GEUS00-55	1	812	1	812	3	815	896	4235	1	812	944	2613	991	2	
GEUS00-56	1	3191	1	3191	5	3197	896	13751	1	3192	944	7371	991	6,732	727
GEUS00-57	1	2361	1	2361	1	2362	896	10431	1	2361	944	5711	991	2	
GEUS00-58	1	1221	1	1221	1	1222	896	5871	1	1221	944	3431	991	2	

GEUS00-59	1	1663	1	1663	1	1664	896	7639	1	1663	944	4315	991	2
GEUS00-60	1	1199	1	1199	4	1203	896	5783	1	1199	944	3387	991	2
GEUS00-61	1	4982	1	4982	1	4983	896	20915	1	4982	944	10953	991	2
GEUS00-62	1	1948	1	1948	1	1949	896	8779	1	1948	944	4885	991	2
GEUS00-63	1	628	1	628	1	629	896	3499	1	628	944	2245	991	2
GEUS00-64	1	8679	1	8679	1	8680	896	35703	1	8679	944	18347	991	2
GEUS00-65	1	1065	1	1065	8687	9752	896	5247	1	1065	944	3119	991	8688
GEUS00-66	1	1416	1	1416	1	1416	896	6651	1	1416	944	3821	991	
GEUS00-A	1	1112	1	1111	1	1112	896	5435	1	1112	944	3213	991	
GEUS00-B	1	200	1	200	1	200	896	1787	1	200	944	1389	991	

* 54-56,417,432,436,439,440,447,454,458-462,466,468,488,508,515,613,2040

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