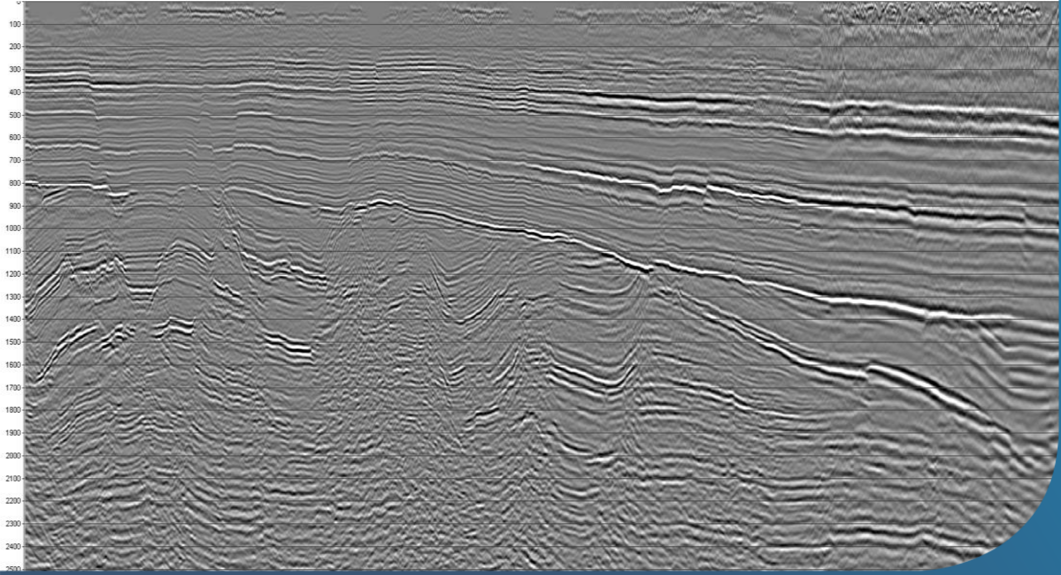

SCAN 2D reprocessing closeout report

Author: Johannes Rehling
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EBN B.V.
Daalsesingel 1
3511 SV Utrecht
The Netherlands

Telefoon: +31 30 233 9000
E-mail: ebn.mail@ebn.nl
Website: www.ebn.nl

KvK-nummer : 14026250
BTW-nummer: NL001726614B01

Management summary

As part of the SCAN project (Seismische Campagne Aardwarmte Nederland), EBN's GTO team was tasked in early 2018 with the reprocessing of 2D onshore vintage seismic data. The aim of the reprocessing project was to supplement the newly acquired SCAN 2D seismic data with state-of-the-art reprocessing of vintage 2D data.

As part of the SCAN project, a total of 11 reprocessing projects were executed, comprising 451 vintage 2D seismic lines with a total line length of some 7.504 km. The projects were executed between October 2018 and August 2023.

This report provides details on the reprocessing projects executed by SCAN, gives an overview of the applied 2D seismic processing sequence, summaries key learning, discusses observations and identified issues made during the reprocessing and shows some selected examples of the reprocessing outcome.

Table of Contents

1. Scope of work

As part of the SCAN project (Seismische Campagne Aardwarmte Nederland), EBN's GTO team was tasked in early 2018 with the reprocessing of 2D onshore vintage seismic data. The aim of the reprocessing project was to supplement the newly acquired SCAN 2D seismic data with state-of-the-art reprocessing of vintage 2D data.

More than 10.000 2D seismic lines have been acquired onshore in the Netherlands since the 1950s when exploration for oil and gas started. From this pool of lines, a total of 972 lines were identified as geologically interesting/ relevant for the project and were further analysed for data availability and completeness. Eventually, 451 lines with a combined line length of 7.504 km were selected by the SCAN interpreters for reprocessing.

The line selection was driven by the following criteria:

- Long regional lines, preferable with relative modern high-fold acquisition parameters
- Areas with significant heat demand
- Areas close to potential SCAN drilling locations
- Lines with well ties
- General preference was given to dip lines rather than strike lines
- Lines were currently no migrated data was available
- Lines that intersect with SCAN lines, other reprocessing lines or which connect with a 3D survey
- Lines running through urban areas, where the acquisition of new data would be rather difficult

The following criteria were applied for lines not considered important for reprocessing projects:

- Recently reprocessed by other companies
- Closely overlapping with the newly acquired SCAN lines
- Rather short lines
- Lines running mainly outside of the SCAN areas A to I.

The purpose of the SCAN 2D seismic reprocessing project was to obtain state-of-the-art 2D broadband PreSTM (Pre-Stack Time Migration) data in all SCAN areas. Some of the key objectives were as follows:

- Obtain comparable PreSTM imaging quality compared to new SCAN 2D PreSTM stack products, and improvement over legacy benchmark PreSTM stacks.
- Improved imaging and fault definition
- Increasing seismic resolution through broad-band processing
- Improved signal-to-noise
- Delineation of presence and thickness of classical reservoirs
- Indication (qualitative) of clastic reservoir properties
- Improved imaging of top, base and geometries of the Dinantian carbonates.

2. 2D seismic vintage field data retrieval

The retrieval of the 2D seismic vintage field data turned out to be much more time consuming than initially thought. After EBN had identified the initial lines a total of 972 lines, a request was made to TNO, which serves as the Dutch Seismic Data Repository, to provide the data to EBN.

However, it became quickly apparent that for very few of the requested lines the seismic field data, observer logs and navigation data was readily available at TNO. This meant that TNO had to approach current and past oil & gas operators to request the provision of the 2D seismic vintage data. Once data shipments were received by TNO, a lot of time was spent checking the data completeness/ consistency between seismic data, observer logs and navigation data. For a 2D seismic line to be reprocessable, for every seismic shot recorded an entry in the observer logs is required as well as the respective shot station and receiver stations in the navigation data. If this data is not consistently available throughout the full line it cannot be reprocessed. Details on the workflow developed by TNO can be obtained from EBN.

Early on during the data retrieval and QA/QC effort it became clear that TNO's seismic data management team did not have sufficient resources to perform this work. To avoid delays of the SCAN reprocessing, EBN provided the financial resources needed to employ 1 to 2 students to work in TNO's seismic data management team, solely focussing on the 2D vintage data preparation.

Over the period from August 2018 to November 2022 a total of 8 students were tasked with the SCAN data preparation and they spent more than 6250 hrs working for the SCAN project. Without this dedicated effort, it would not have been possible to complete the reprocessing for SCAN by August 2023.

In addition, the EBN reprocessing project managers spent an additional 300 hrs of their time to interface with the TNO staff as well as SCAN interpreters to facilitate the data retrieval work.

3. Reprocessing projects

The reprocessing projects were executed between October 2018 and August 2023. To keep the individual reprocessing projects manageable from a project management and QA/QC perspective, the total amount of 451 lines was split into 11 reprocessing projects.

Batch No.	Contractor	Project name	Contract number	Number of lines	Line km	Cumulative line km	Full fold km	Cumulative full fold km
1	DMT Petrologic	Mobil 2D reprocessing	GTO-18-C004	24	315	315	250	250
2	Geofizyka Toruń S.A.	NAM-DEEP 2D reprocessing	GTO-19-C011	1	268	583	256	506
3	TEEC GmbH	Mobil/NAM 2D reprocessing	GTO-19-C033-01	44	515	1.098	412	918
4	TEEC GmbH	Petroland 2D reprocessing	GTO-19-C033-02	51	805	1.904	628	1.547
5	Geofizyka Toruń S.A.	NAM Zeeland 2D reprocessing	GTO-19-C032-01	56	974	2.877	869	2.415
6	Geofizyka Toruń S.A.	Flevoland Waterland 2D reprocessing	GTO-19-C032-03	37	689	3.567	612	3.027
7	TEEC GmbH	Brabant Oost BP 2D reprocessing	GTO-19-C033-03	29	625	4.192	489	3.516
8	TEEC GmbH	Brabant Salland 2D reprocessing	GTO-19-C033-04	41	777	4.969	626	4.142
9	Geofizyka Toruń S.A.	Holland-Twente 2D reprocessing	GTO-19-C032-04	55	902	5.870	826	4.968
10	TEEC GmbH	Brabant C-plus 2D reprocessing	GTO-19-C033-05	68	835	6.664	673	5.641
11	Geofizyka Toruń S.A.	IJsselmeer B-plus 2D reprocessing	GTO-19-C032-05	45	798	7.504	693	6.334
			Totals:	451	7.504		6.334	

Table 1: List of projects, project names and contract numbers

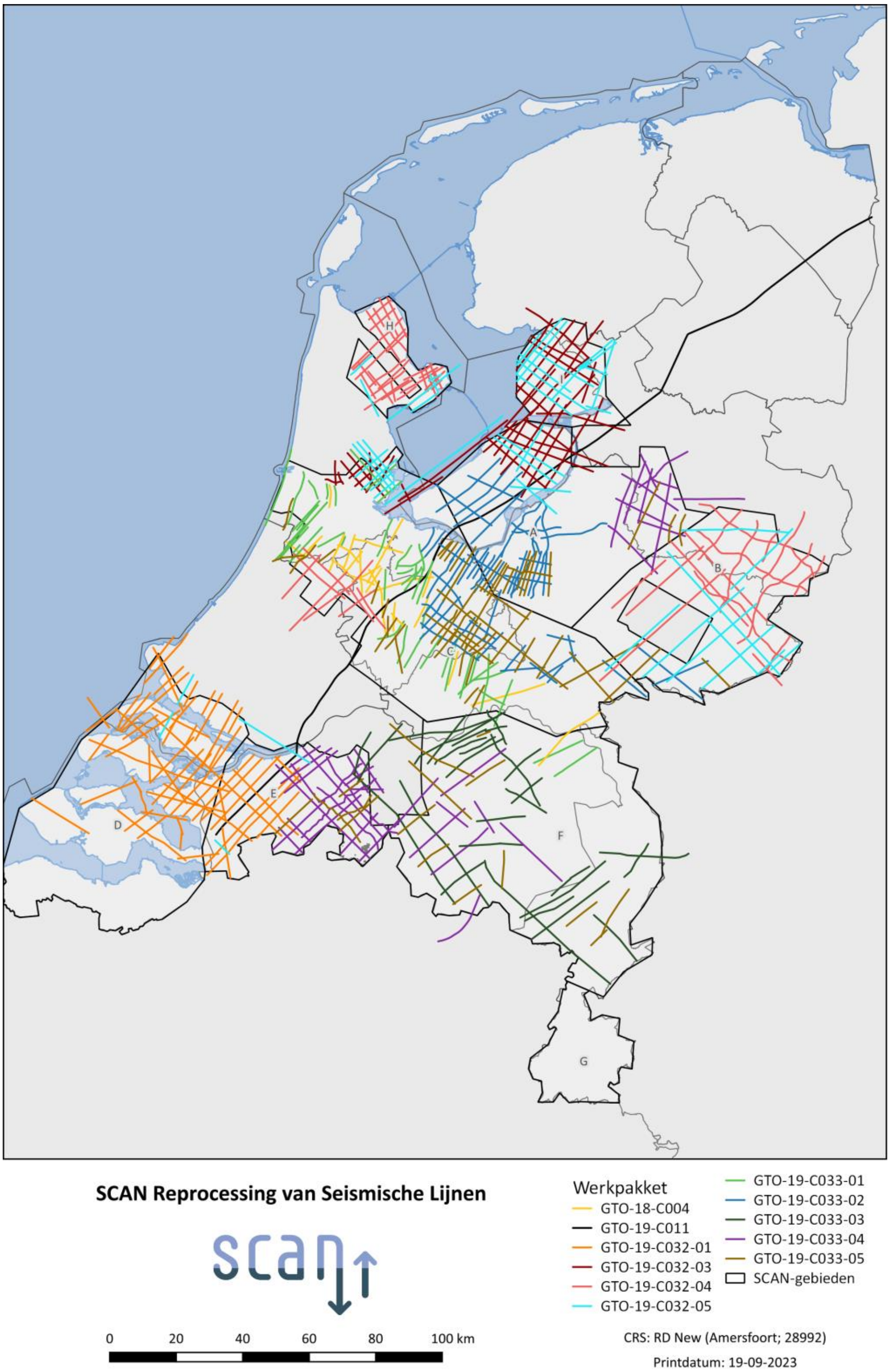


Figure 1: Location of reprocessed lines, colour coded by the reprocessing contract number.

Figure 1 shows the location of the individual lines, colour coded by the reprocessing contract number and table 1 gives the list of projects, detailing the reprocessing contractors, project names, reprocessing contract numbers and quantity of reprocessed lines, and respective line and full fold kilometres reprocessed per project.

4. Seismic reprocessing contractors

The work was performed between October 2018 and August 2023 by 3 different processing contractors, namely DMT Petrologic GmbH (1 project), Geofizyka Toruń S.A. (5 projects) and TEEC GmbH (5 projects).

The reason that DMT Petrologic GmbH only performed one project is that the first project was tendered as "stand-alone" project before EBN had performed a seismic processing contractor technical pre-qualification tender to setup (re)processing framework agreements. By offering a very competitive price combined with a reasonable technical proposal, DMT Petrologic GmbH was able to win the first reprocessing contract.

During 2019 EBN carried out an extensive seismic processing technical pre-qualification tender. During this tender DMT Petrologic GmbH then failed to meet EBN's minimum technical requirements and was not awarded a 2D processing framework contract and therefore was excluded from any further reprocessing projects.

As outcome of this pre-qualification tender, seismic 2D (re)processing framework agreements were signed with DownUnder GeoSolutions (DUG) in London, Geofizyka Toruń S.A. in Poland and TEEC GmbH in Germany.

4.1 Project split between contractors

The split of work for each contractor was as follows:

- DMT Petrologic: 1 project, 24 lines, 315 line km
- Geofizyka Toruń S.A.: 5 projects, 194 lines, 3.631 line km
- TEEC GmbH: 5 projects, 233 lines, 3.557 line km

Total combined: 451 lines, 7.504 line km

5. Seismic reprocessing sequence

All seismic reprocessing projects were processed through a state-of-art broadband seismic processing sequence and were supervised by a dedicated EBN project manager.

While the processing sequences for the individual projects might vary slightly based on each of the contractors' software packages, acquisition parameters or geological complexity, the pre-migration seismic processing sequence can be summarised as follows:

- Reformat and identing
- Start-of-Data Time Correction
- Field edits (from observer logs)
- Anomalous trace editing
- Spherical Spreading Correction
- Refraction static
- Instrument and geophone phase correction
- Large noise attenuation effort by using various noise attenuation techniques such as anomalous high energy despike, monochromatic noise attenuation, frequency dependent noise attenuation, linear noise attenuation, FX noise attenuation, spectral decomposition noise attenuation and wavelet transform filtering, applied in shot, receiver and CDP domain
- Low-cut frequency filtering

- Inverse Q amplitude and phase compensation
- Surface consistent deconvolution, 16 ms gap, 160 ms operator length
- 2 passes of surface consistent amplitude compensation
- 2 passes of residual statics
- 2 passes of stacking velocity picking
- Radon demultiple, starting below Base North Sea when deemed necessary
- AGC (for versions with AGC only)

The passes of surface consistent amplitude compensation, residual statics and stacking velocity picking were interleaved with each other to improve the seismic image in an iterative manner.

- The migration was an isotropic Pre-Stack-Time-Migration (PreSTM) with at least 2 passes of PreSTM velocity model updating, a migration aperture of 2500m and a migration dip limit of 30 to 35 degrees, sometimes modified to cater for geological complexity.

The post-migration processing sequence consisted of:

- Radon demultiple, starting below Base North Sea
- Several passes of pre-stack of noise reduction in CMP and/or common offset domain
- Trim statics
- Residual moveout picking
- Mute picked as time – offset pairs, generally representing a mute angle of 40 to 45 degrees.
- AGC (for versions with AGC only)
- Post-stack spectral broadening or whitening
- Several more passes of noise attenuation such as
- Time-variant filtering

Depending on the number of lines and kms to be processed, EBN selected between 4-8 test lines for each processing project. The test lines were carefully chosen together with the SCAN interpreters to give a representative sample of subsurface geology as well an appropriate sample for the various acquisition geometries and seismic source types.

For all but the first project the final Pre-Stack-Time-Migrations were produced in duplicate sets, one version being a “true relative amplitude” (TA) version and one “amplitude-gain compensation” (AGC) version with pre-migration as well as pre-stack and/or post-stack AGC scaling applied to the data. The TA version should be used when true amplitude work is required or when the data will be used for rock property work such as seismic inversions, while the AGC version, with better balanced amplitude in time, should be used foremost for structural interpretation.

Please note, the earlier projects had slightly less deliverables compared to the latest projects, as the list of deliverables was fine-tuned throughout the first few reprocessing projects.

6. Project management/ QA & QC

To get the best possible reprocessing result, EBN assigned a dedicated project manager for each reprocessing project. The task of the project manager started with the preparation of the tender documentation in conjunction with the EBN procurement team. Except for the first 2 projects, each reprocessing project was tendered as a mini-tender under the existing land 2D processing framework agreements with DownUnder GeoSolutions (DUG), Geofizyka Toruń S.A. and TEEC GmbH.

After the bids were received, at least 2 to 3 EBN staff and for most reprocessing projects an external geophysical advisor evaluated the bids independently from each other, after which a joint meeting was held with an EBN procurement staff to come to a joint tender evaluation. After the winning bid was established, the EBN project manager would proceed with the writing of the reprocessing workorder, which represents the project initiation with the processing contractor.

An exception to this procedure were the last two projects, the Brabant C-plus and the IJsselmeer B-plus projects. In the view of turnaround time and contractor availability, TEEC and Geofizyka Toruń were each offered one project with identical processing rates as they had offered for the latest earlier projects they had won.

Each reprocessing project was started with a kick-off meeting held between the EBN project manager, SCAN interpreter and the contractor staff assigned to the project. Due to the Covid Pandemic between early 2020 and late 2022, the kick-off meetings had to be held remotely via Teams Meetings for all but one of the reprocessing projects.

Throughout the reprocessing projects the contractors provided weekly progress reports, detailing the work completed during the prior week and currently ongoing activities. Project progress was then discussed in an online weekly Teams Meeting. Processing test results were provided to EBN in form of large PowerPoint files, detailing the input data, the output data and where applicable the difference between them to better understand the effectiveness of the applied processing setup and to safeguard data quality.

Invoicing for the projects was done at the end of each month for work completed during the same month. Invoices were only accepted for work performed, not for forward looking activities and the final invoice was only released for payment once EBN had received the full set of processing deliverables, 2 identical copies on tapes and 2 identical copies on USB HHDs.

7. Key lessons learned

The key lessons learned from the execution of the SCAN reprocessing projects are as follows:

1. **Seismic data selection:**
When a large pool of vintage data is available for reprocessing, preference should be given to the most modern acquisition designs, e.g., highest fold with dense receiver and shot spacing. However, this can sometimes contradict with the 2nd key lesson, as it was found that old explosive seismic, and thereby relative lower fold, was often easier to reprocess than even the most modern and high-fold Vibroseis data.

2. **Seismic source selection:**
During the SCAN reprocessing projects it was found that 2D seismic lines acquired with Vibroseis sources were generally far more difficult to reprocess than lines acquired with (deep) explosive sources.

3. **Vintage data preparation:**
QA/QC of the vintage seismic and non-seismic input data can be very time consuming and if left to the seismic processing contractor, can result in significant extra costs not covered by the base processing rate. Preferable, this item is to be sorted out upfront so that “ready to be processed” data packages can be provided to the seismic processing contractor.

4. **Velocity picking:**
Early in the processing sufficient time needs to allocate to pick good quality stacking velocities, which will be used for brute stacks to judge the quality of the signal processing.
During the velocity picking for the migration, intersection QC is required to ensure consistent velocity picking throughout each individual project. In later projects, data from earlier projects should also be used to ensure data consistency between various reprocessing projects.

5. **Seismic Imaging:**
For the SCAN reprocessing project isotropic pre-stack Kirchhoff Time Migration was the selected imaging technique. While this is not the most technically advanced seismic imaging technique, it is a robust method that provides high-quality results for the regional aspect of the SCAN reprocessing projects.

6. **Zerophasing:**
Zerophase for land seismic data with sparse well control is very difficult to achieve. The end-user of the reprocessing projects should do the best effort to QC the phase and where possible, perform seismic to well ties to compensate for any possible residual phase error.

7. **Scaled & unscaled migration:**
It has shown to benefit the usefulness of the final PreSTMs to have a relative true amplitude migration and an AGC scaled version.

8. **Coordinate systems:**
Prior to commencement of the reprocessing it must be clearly communicated by all parties in which coordinate system the final deliverables have to be prepared. Last minutes changes in the output coordinate system will result in additional costs and project delays.

8. Discussion of key learnings, processing sequence and result

An unexpected large effort was required to locate, retrieve and QA/QC of the vintage seismic and non-seismic input data such as navigation data and observer logs. While strictly speaking TNO manages the Dutch National Data Repository, a lot of the old vintage 2D lines were NOT readily available for reprocessing. TNO's data management group had to contact current and past Oil & Gas operators to request the old 2D field data. Once the data arrived at TNO, a lot of time was spent to check it for completeness. To perform 2D seismic reprocessing, the old shot field data, the navigation data and the observer logs must be available. If that was the case, then the data was checked for completeness, e.g., were all shots mentioned in the observer logs available as SEGY files and was navigation data available for each shot point and geophone position.

Early in the SCAN reprocessing effort it was notice that TNO could not provide the required resources to perform the QA/QC of the vintage data with any reasonable turn-around time. Instead, it was agreed that TNO would engage Earth Science students who would perform the data QC under TNO's supervision. Regular project progress meetings were held between TNO and EBN to monitor the progress and to discuss data quality issues. More information on the applied QA/QC workflow can be obtained from EBN.

In total more than 6.500 hrs were spent on the QA/QC of the vintage data and the budget required to perform this work was made available by EBN from the SCAN budget.

As for any reprocessing, the aim is to improve on the processing results achieved during the earlier vintage processing. For the SCAN reprocessing effort, this has been achieved for some 80-85% of reprocessed lines. For the remaining 15-20% of lines, the quality of imaging was not (significantly) improved. In some cases, it was even observed that obvious seismic multiples remained in the data after the reprocessing.

Generally speaking, the best reprocessing results could be achieved with seismic data vintages from the early to late 1980s. The reason is thought to be the introduction of the Sercel SN348 recording instrument to the seismic marked. Prior to that technical improvement, the recording of seismic data was limited to a maximum of 120 channels or less. The introduction of the Sercel SN438 recording instrument led to an increase of the maximum seismic data recorded per shot to a maximum of 480 channels.

The higher channel count has several advantages, as it allows for higher fold, which benefits the signal-to-noise ration and/or allows for the acquisition of much larger offsets, which benefits the imaging of structurally complex geological settings. Having more seismic traces in shot or common-mid-point domain also allows for more sophisticated processing algorithms such as noise attenuation processes to work much better, as it is easier to discriminate between signal and noise in the pre-stack domain.

It was also found during the reprocessing projects that seismic data acquired with explosive sources with relative larger charges sizes and deep shot holes (e.g., 1 x 100g at 10m depth) were easier to reprocess than light charges (e.g., 12 x 125g at 2m depth).

The seismic image quality of seismic data acquired with Vibroseis sources was often exceedingly difficult to improve compared to the vintage seismic. For Vibroseis acquisition the age of acquisition was less relevant for the outcome of the reprocessing, even the highest fold (between 80 to 350) and relatively young surveys were difficult to reprocess.

It is rather difficult to name a single reason for this. It seems that Vibroseis sources generally have difficulties to get "enough" energy into the subsurface. Particularly close to infrastructure, the vibrator drive levels need to be adjusted downwards to minimize the risk of damage. At the same time, with the vibrator sources on the surface compared to explosive sources deep in the subsurface, shots acquired by Vibroseis source suffer from stronger ground role and often very little seismic reflection signal could be detected within the so-called ground role cone. Instead, the ground role cone was flooded with excessive high frequency, high amplitude noises, which represented a great challenge for the noise attenuation processes.

In addition, the first-break picking for the refraction statics computation was also often far more difficult on the Vibroseis lines compare to line acquire with (deep) explosive sources due to the absence of clear first breaks.

Some of the older vibroseis surveys also suffer from a lack of low frequencies, with the sweep often starting at 14 or 18 Hz and /or a very narrow sweep frequency band (e.g., 15-48Hz, 14-64 Hz, 18-64 Hz or 18-72Hz). However, it is particularly those low frequencies that are important for imaging deep structures and to achieve a broad-band seismic image.

The more modern vibroseis surveys used a broader sweep of 10-94 Hz or 12-110 Hz, but such sweeps then caused significant amount of high frequency, high amplitude in the noise cone, as mentioned earlier.

For all reprocessing projects refraction statics was the chosen method to account for near surface velocity. While generally this worked very well, some lines suffered from false structure" in low-dip Tertiary North Sea Supergroup. This might be attributed to very low-fold, short offset data, suboptimal or unstable long- or short-wavelength and not very effective residual statics solutions.

While every effort was made to have statics consistent between intersecting lines for each of the individual projects, consistency between projects could unfortunately not be ensured. Relative to the newly acquired SCAN data, which served as the master survey, for some of the reprocessing projects time shifts and/or polarity changes were applied to individual lines to improve the final data match. This has been document in the respective reprocessing reports.

The same is valid for seismic and velocity intersection. Careful QC was done for project internal intersections and the later stage projects were also checked against the newly acquired SCAN lines, which were not available for the earlier part of the reprocessing effort.

While most of the seismic data did not suffer from strong seismic multiple, some lines did show some long-period multiple contamination. In the processing a pre-migration Radon demultiple was applied with a relative mild (=safe) multiple removal. In the earlier project this pre-migration demultiple was always applied, while in the later projects it was only applied when obvious multiple could be detected. During the post-migration processing a tighter Radon demultiple was applied. While the effect on the final image was often negligible, the pre-stack data quality improved greatly, and therefore the post-migration demultiple was applied for all projects.

More sophisticated demultiple techniques like 2D SRME (Surface-related multiple Elimination) were not part of the basic processing sequence. Given the relative low level of multiple contamination of the data and the often difficult SRME parameterization testing it was not deemed a necessary processing step for the purpose of a large regional reprocessing effort.

Pre-Stack-Time-Migration (PreSTM) was the chosen imaging technique for all reprocessing projects, while almost all vintage data was imaged using a Post-Stack-Time-Migration (PostSTM). In a PostSTM the data get stacked pre-migration and subsequently migrated, while in the PreSTM each offset slot in pre-stack CMP domain gets migrated individually and then the data get stacked at a much later stage in the processing once the post-migration pre-stack processing is completed.

The major advantage of the PreSTM workflow is that is allows for migration velocity picking in migrated domain, and several passes of migrations and velocity picking can be done to fine-tune the final migration velocities, thus giving a far more reliable velocity model. Once the data is migrated and still in pre-stack domain, demultiple and noise attenuation processes can be applied to the data, which is not possible for a PostSTM. Another advantage of PreSTM is that it can image dipping events much better than PostSTM, particular for steeply dipping events at greater depth.

PreSTM imaging has however one disadvantage, it is more prone to introducing migration noises (migration smiles) into the final image. This is particularly obvious if the input data to the PreSTM still has seismic traces with excessively high amplitude samples. These high amplitudes then get "smeared out" into the seismic image and can then interfere with steeply dipping events. This can somewhat be mitigated by post-migration dip filtering, but the dip filter needs to be carefully designed to remove only migration noises and leave dipping geology un-touched; a fine line to trade.

2 iterations of PreSTM velocity picking were part of the base processing and were usually sufficient to achieve a good PreSTM velocity model. Particularly for the older vintage with only short offsets, the velocity picking became rather unsensitive, as long offsets are required to confidently review any residual moveout of the CMP image gathers.

Given the time available and the huge task of reprocessing as many lines as possible by August 2023, PreSTM was thought to be the most suitable imaging technique. More advanced 2D imaging techniques such as 2D Pre-Stack Depth Migration (PreSDM) or 2D Reverse Time Migration (RTM) were considered too time extensive and too expensive for the purpose of such a large regional reprocessing effort.

For the newly acquired SCAN data a 2D PreSDM and 2D RTM imaging test was performed in 2020, but even for those new lines it was decided that the imaging uplift would not justify the extra time (+/- 3 months for a single 2D line) and the additional cost required. Running 451 vintage 2D lines through individual PreSDM processing would not have been achievable in any reasonable timeframe.

For each of the reprocessing projects two sets of final PreSTMs (for full offset, near & far volumes) were delivered, one with relative true amplitude processing to allow for possible AVO studies and one version with pre-migration and post migration AGC scaling applied. The AGC version is not true amplitude and should therefore NOT be used for quantitative interpretation studies, but the improved event continuity and stronger amplitudes in some of the poor data areas make this a dataset better suitable for structural interpretation.

One exceedingly difficult issue with land seismic acquisition is the ambiguity of the seismic phase. Ideally, seismic to well ties should be performed to confirm the phase of the seismic data, and if necessary, residual phase corrections can then be applied. For the earlier reprocessing projects, a statistical zero-phasing was applied at the end of the reprocessing flow, assuming that the input data is truly minimum phase.

Once a number of newly acquired and processed SCAN lines were available for phase comparisons, the new SCAN data was used to “calibrate” the reprocessed lines. When needed, either time shifts and/ or phase shifts were applied to achieve the best possible match.

For all reprocessing projects pre-migration CMP gathers as well as migrated image gathers (raw and final) were part of the project deliverables.

In case any user of the reprocessing products feels that more advanced demultiple or imaging would improve that data quality in a particular local area, those pre-migration CMP gathers can be used to apply additional demultiple, or higher end seismic imaging techniques such as PreSDM or RTM.

The final image gathers can be used to perform pre-stack quantitative interpretation work.

In late 2022 VITO unexpectedly contacted EBN to inquire if 2 of their 2D seismic lines from survey NWL20 (lines 01 & 02) could be added to one of our projects, the Brabant Salland project. In the Brabant Salland project, we had already included line NWL20-03 for the SCAN project scope, as that line runs partly through the south of the Netherlands. The costs related to reprocessing these two lines have not been charged to the SCAN budget.

While setting up agreements with VITO as well as TEEC, the processing contractor for the Brabant Salland project, was quickly accomplished, all parties overlooked the issue that in Belgium a different coordinate system is used that in NL. Very late into the reprocessing of the 2 lines VITO requested the data to be delivered in Lambert coordinates instead of the Amersfoort RD New coordinates.

9. Examples of reprocessing results

The following figures give a few examples of the vintage data and the reprocessing results.

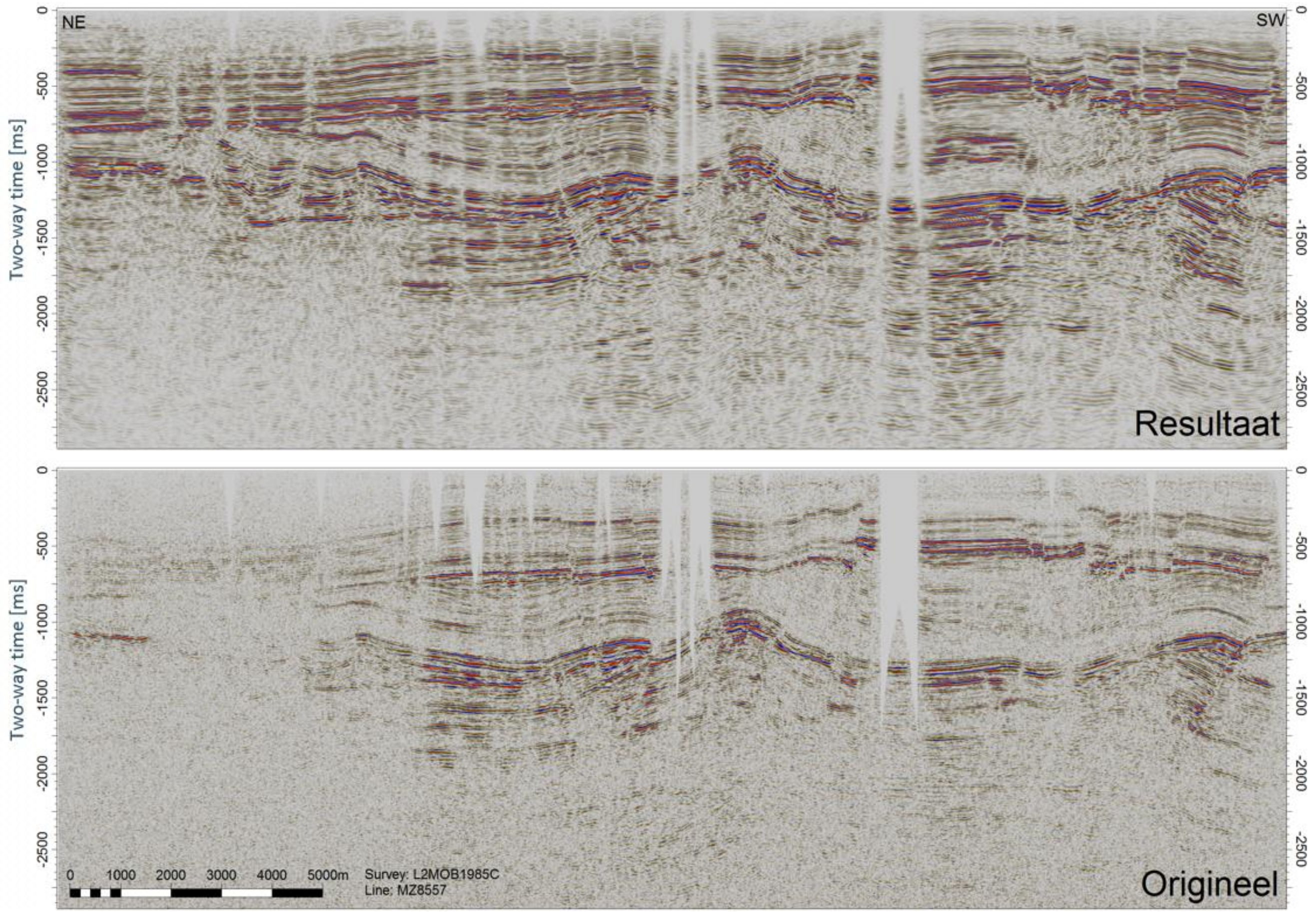


Figure 2: Line MZ8557, vintage L2MOB1985A, from Mobil 2D reprocessing (GTO-18-C004), reprocessed result top, vintage processing bottom

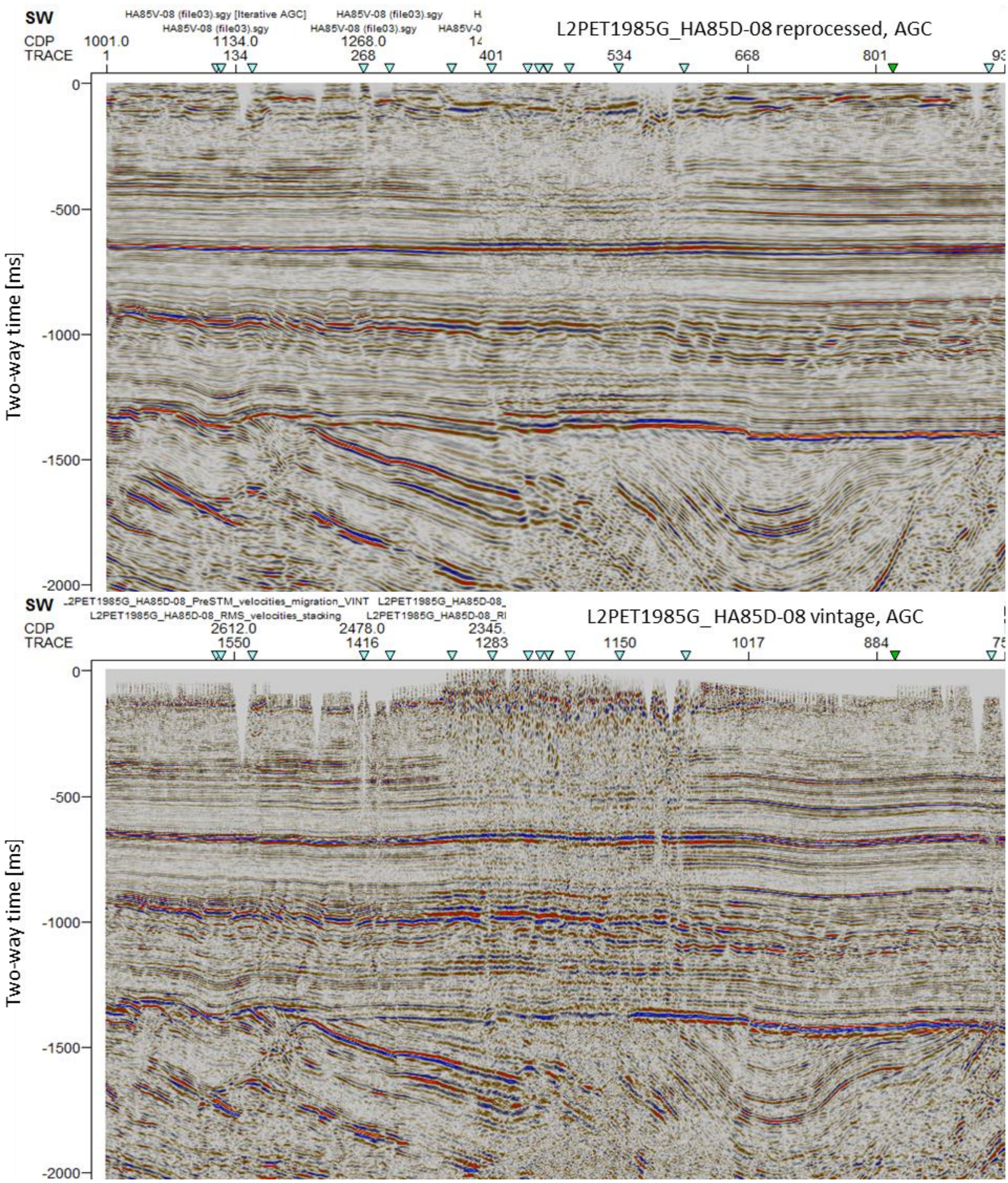
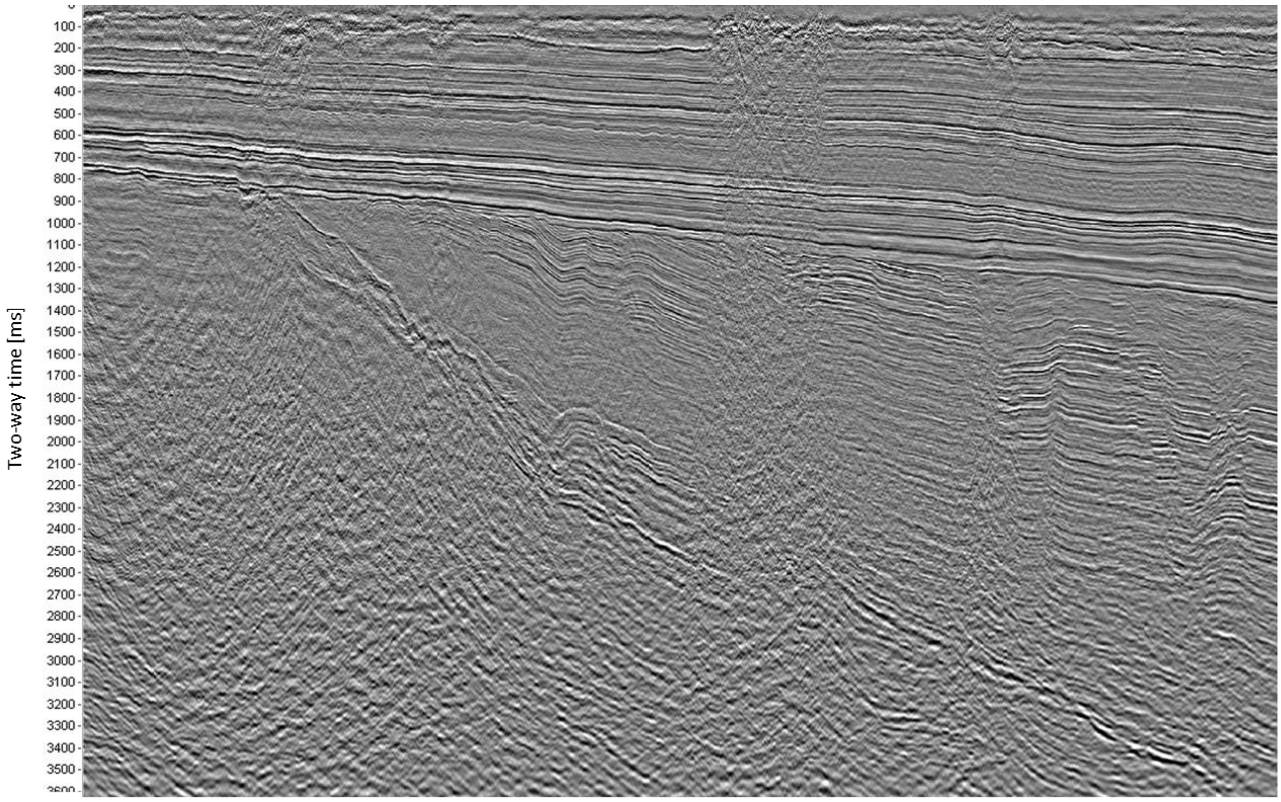


Figure 3: Line HA85D-08 (zoom-in), vintage L2PET1985G, from Petroland 2D reprocessing (GTO-19-C033-02), reprocessed result top, vintage processing bottom



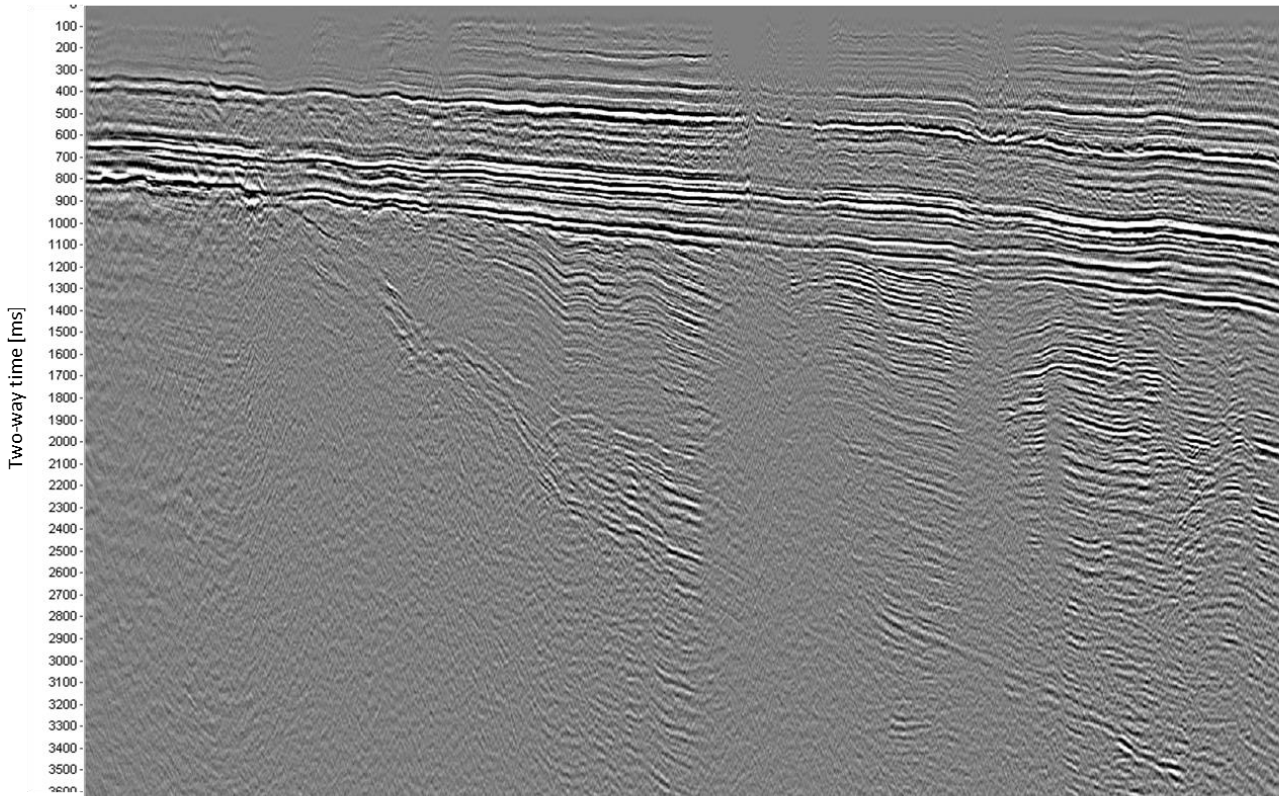


Figure 4: Line 846012, vintage L2NAM1984B, from NAM Zeeland 2D reprocessing (GTO-19-C032-01), reprocessed result top, vintage processing bottom.

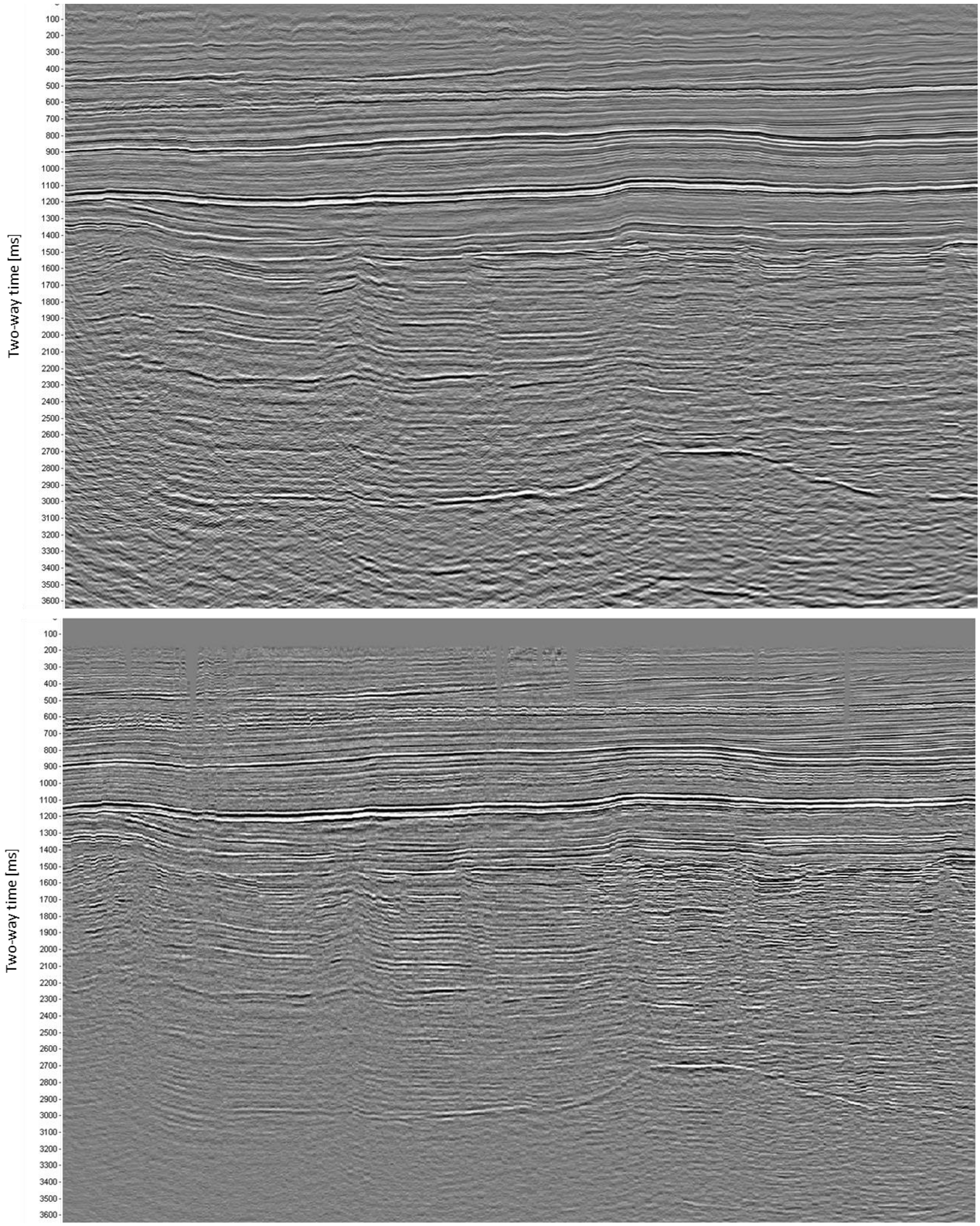


Figure 5: Line 803007, vintage L2NAM1980G, from Flevoland – Waterland 2D reprocessing (GTO-19-C032-03), reprocessed result top, vintage processing bottom.

10. Seismic data availability TNO/NLOG

All reprocessed data (except for the pre-stack processed gathers) is available for downloading from TNO's NLOG website: https://www.nlog.nl/scan-2d-seismische-data.

For each reprocessing project, the following data is available:

- Shots after identing, 1 file per line
- Final true amplitude PreSTM version (near, far and full volumes), 3 files per line
- Final AGC scaled PreSTM version (near, far and full volumes), 3 files per line
- RMS stacking velocity, SEGY format: 1 file per line
- RMS stacking velocity, ASCII format: 1 file per line
- Final PreSTM RMS velocities, SEGY format: 1 file per line
- Final PreSTM RMS velocities, ASCII format: 1 file per line
- Final PreSTM interval velocities, SEGY format: 1 file per line
- Final PreSTM interval velocities, ASCII format: 1 file per line
- Final stacking mute: 1 file per line

In addition to the above seismic volumes, a reprocessing report is available for each project too. Each reprocessing report includes a list of the lines reprocessed and the project deliverables.

Exceptions to the above project deliverables list:

- The project GTO-18-C004 (Mobil 2D reprocessing) has all of the above deliverables, except for the AGC scaled PreSTMs and the PreSTM interval velocities. These additional set of deliverables were introduced to the processing workflow after this first reprocessing project was completed.

- The project GTO-19-C011 (NAM Deep 2D reprocessing) consisted of only ONE merged output line. The migration was an anisotropic PreSTM, and therefore the deliverables include the ETA fields, in ASCII and SEGY format. The seismic SEGY full stack data comes in 2 versions, one processed as is and one with a 90 degree phase rotation, to match with the performed well tie.

11. Project Close-Out Approval

The undersigned confirm that they have reviewed the project close-out report and agree with its contents.

Signature:		Date:	13.10.2023
Name:	Johannes Rehling		
Function:	Senior Geophysicist Warmtetransitie Operations		

Signature:		Date:	13.10.2023
Name:	Gitta Zaalberg		
Function:	Manager Warmtetransitie Operations		