November 21st, 2024

9th Dutch Exploration Day

Seismic Data Processing of the Southern North Sea's first OBN survey

Technical challenges & achievements

Part 2: Jeroen Beishuizen – Processing Geophysicist, Shell Global Solutions International B.V.
Yvan Charreyron - Asset Geophysicist, Nederlandse Aardolie Maatschappij B.V.
Xander Campman – Contract Holder, Operations Geophysicist, Shell Global Solutions International B.V.
Dhwajal Chavan – Project Manager, Operations Geophysicist, Shell Global Solutions International B.V.

Definitions & cautionary note

Cautionary Note

The companies in which Shell plc directly and indirectly owns investments are separate legal entities. In this **presentation**"Shell", "Shell Group" and "Group" are sometimes used for convenience where references are made to Shell plc and its subsidiaries in general. Likewise, the words "we", "us" and "our" are also used to refer to Shell plc and its subsidiaries in general or to those who work for them. These terms are also used where no useful purpose is served by identifying the particular entity or entities. ''Subsidiaries'', "Shell subsidiaries" and "Shell companies" as used in this **presentation** refer to entities over which Shell plc either directly or indirectly has control. The term "joint venture", "joint operations", "joint arrangements", and "associates" may also be used to refer to a commercial arrangement in which Shell has a direct or indirect ownership interest with one or more parties. The term "Shell interest" is used for convenience to indicate the direct and/or indirect ownership interest held by Shell in an entity or unincorporated joint arrangement, after exclusion of all third-party interest.

Forward-Looking Statements

This **presentation** contains forward-looking statements (within the meaning of the U.S. Private Securities Litigation Reform Act of 1995) concerning the financial condition, results of operations and businesses of Shell. All statements other than statements of historical fact are, or may be deemed to be, forward-looking statements. Forward-looking statements are statements of future expectations that are based on management's current expectations and assumptions and involve known and unknown risks and uncertainties that could cause actual results, performance or events to differ materially from those expressed or implied in these statements. Forward-looking statements include, among other things, statements concerning the potential exposure of Shell to market risks and statements expressing management's expectations, beliefs, estimates, forecasts, projections and assumptions. These forward-looking statements are identified by their use of terms and phrases such as "aim"; "ambition"; ''anticipate''; ''believe''; "commit"; "commitment"; ''could''; ''estimate''; ''expect''; ''goals''; ''intend''; ''may''; "milestones"; ''objectives''; ''outlook''; ''plan''; ''probably''; ''project''; ''risks''; "schedule"; ''seek''; ''should''; ''target''; ''will''; "would" and similar terms and phrases. There are a number of factors that could affect the future operations of Shell and could cause those results to differ materially from those expressed in the forward-looking statements included in this **presentation**, including (without limitation): (a) price fluctuations in crude oil and natural gas; (b) changes in demand for Shell's products; (c) currency fluctuations; (d) drilling and production results; (e) reserves estimates; (f) loss of market share and industry competition; (g) environmental and physical risks; (h) risks associated with the identification of suitable potential acquisition properties and targets, and successful negotiation and completion of such transactions; (i) the risk of doing business in developing countries and countries subject to international sanctions; (j) legislative, judicial, fiscal and regulatory developments including regulatory measures addressing climate change; (k) economic and financial market conditions in various countries and regions; (l) political risks, including the risks of expropriation and renegotiation of the terms of contracts with governmental entities, delays or advancements in the approval of projects and delays in the reimbursement for shared costs; (m) risks associated with the impact of pandemics, such as the COVID-19 (coronavirus) outbreak, regional conflicts, such as the Russia-Ukraine war, and a significant cybersecurity breach; and (n) changes in trading conditions. No assurance is provided that future dividend payments will match or exceed previous dividend payments. All forward-looking statements contained in this **presentation** are expressly qualified in their entirety by the cautionary statements contained or referred to in this section. Readers should not place undue reliance on forward-looking statements. Additional risk factors that may affect future results are contained in Shell plc's Form 20-F for the year ended December 31, 2023 (available at www.shell.com/investors/news-and-filings/sec-filings.html and www.sec.gov). These risk factors also expressly qualify all forward-looking statements contained in this **presentation** and should be considered by the reader. Each forward-looking statement speaks only as of the date of this **presentation**, **21 November 2024,** Neither Shell plc nor any of its subsidiaries undertake any obligation to publicly update or revise any forward-looking statement as a result of new information, future events or other information. In light of these risks, results could differ materially from those stated, implied or inferred from the forward-looking statements contained in this **presentation**.

Shell's Net Carbon Intensity

Also, in this **presentation** we may refer to Shell's "Net Carbon Intensity" (NCI), which includes Shell's carbon emissions from the production of our energy products, our suppliers' carbon emissions in supplying energy for that production and our customers' carbon emissions associated with their use of the energy products we sell. Shell's NCI also includes the emissions associated with the production and use of energy products produced by others which Shell purchases for resale. Shell only controls its own emissions. The use of the terms Shell's "Net Carbon Intensity" or NCI are for convenience only and not intended to suggest these emissions are those of Shell plc or its subsidiaries.

Shell's net-zero emissions target

Shell's operating plan, outlook and budgets are forecasted for a ten-year period and are updated every year. They reflect the current economic environment and what we can reasonably expect to see over the next ten years. Accordingly, they reflect our Scope 1, Scope 2 and NCI targets over the next ten years. However, Shell's operating plans cannot reflect our 2050 net-zero emissions target, as this target is currently outside our planning period. In the future, as society moves towards net-zero emissions, we expect Shell's operating plans to reflect this movement. However, if society is not net zero in 2050, as of today, there would be significant risk that Shell may not meet this target.

Forward-Looking non-GAAP measures

This **presentation** may contain certain forward-looking non-GAAP measures such as **[cash capital expenditure]** and **[divestments]**. We are unable to provide a reconciliation of these forward-looking non-GAAP measures to the most comparable GAAP financial measures because certain information needed to reconcile those non-GAAP measures to the most comparable GAAP financial measures is dependent on future events some of which are outside the control of Shell, such as oil and gas prices, interest rates and exchange rates. Moreover, estimating such GAAP measures with the required precision necessary to provide a meaningful reconciliation is extremely difficult and could not be accomplished without unreasonable effort. Non-GAAP measures in respect of future periods which cannot be reconciled to the most comparable GAAP financial measure are calculated in a manner which is consistent with the accounting policies applied in Shell plc's consolidated financial statements.

The contents of websites referred to in this **presentation** do not form part of this **presentation**.

We may have used certain terms, such as resources, in this **presentation** that the United States Securities and Exchange Commission (SEC) strictly prohibits us from including in our filings with the SEC. Investors are urged to consider closely the disclosure in our Form 20-F, File No 1-32575, available on the SEC website www.sec.gov.

Part 2. Seismic Processing – Presentation Content

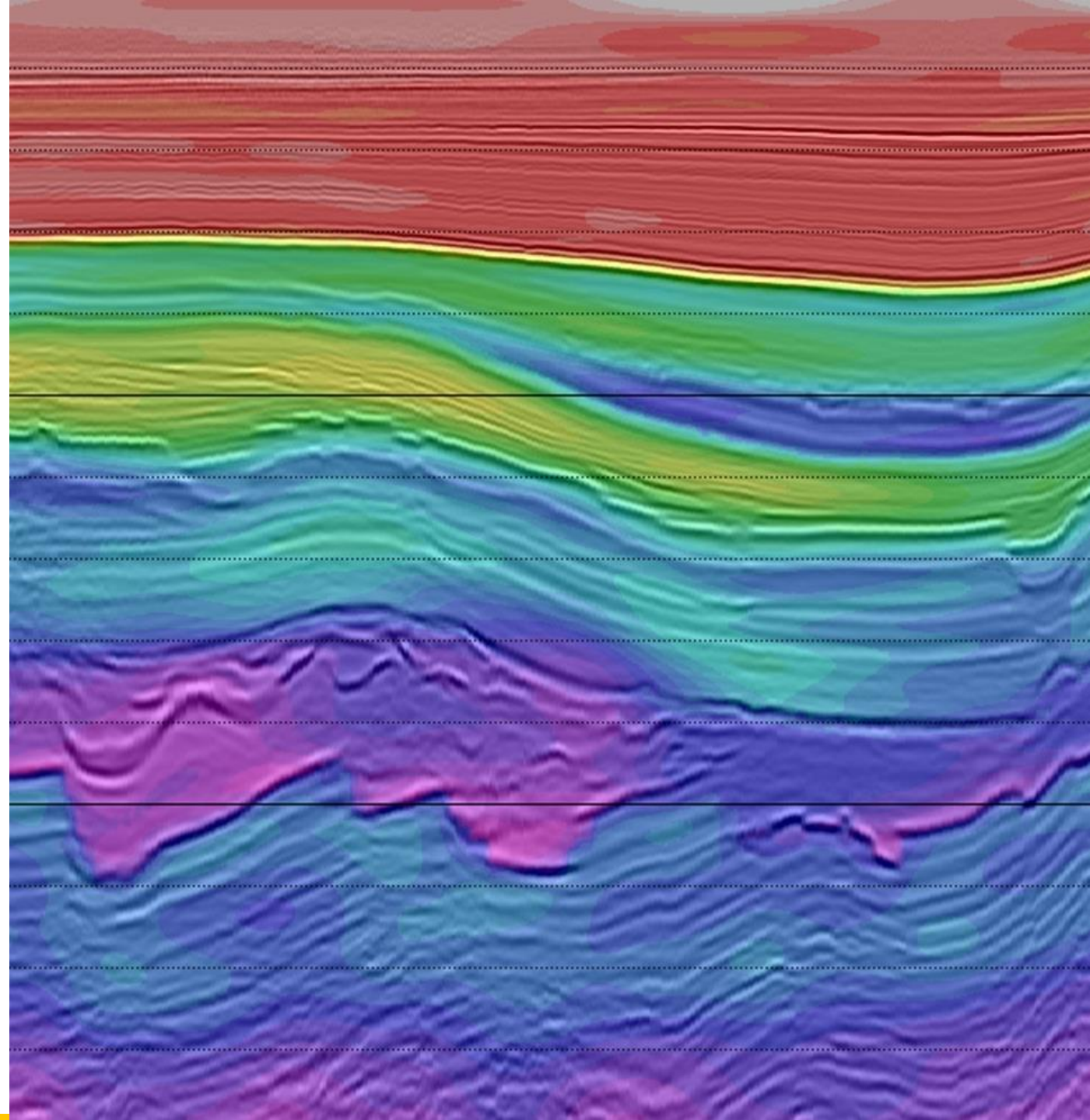
- Seismic Processing
  - Pre-processing
  - Velocity Model building and FWI
  - Imaging

- Summary

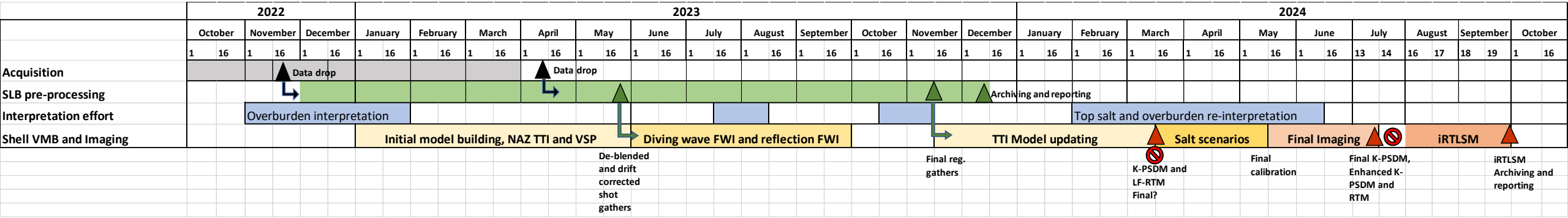
November 21st, 2024
9th Dutch Exploration Day

Processing

Pre-processing, velocity-model building and imaging

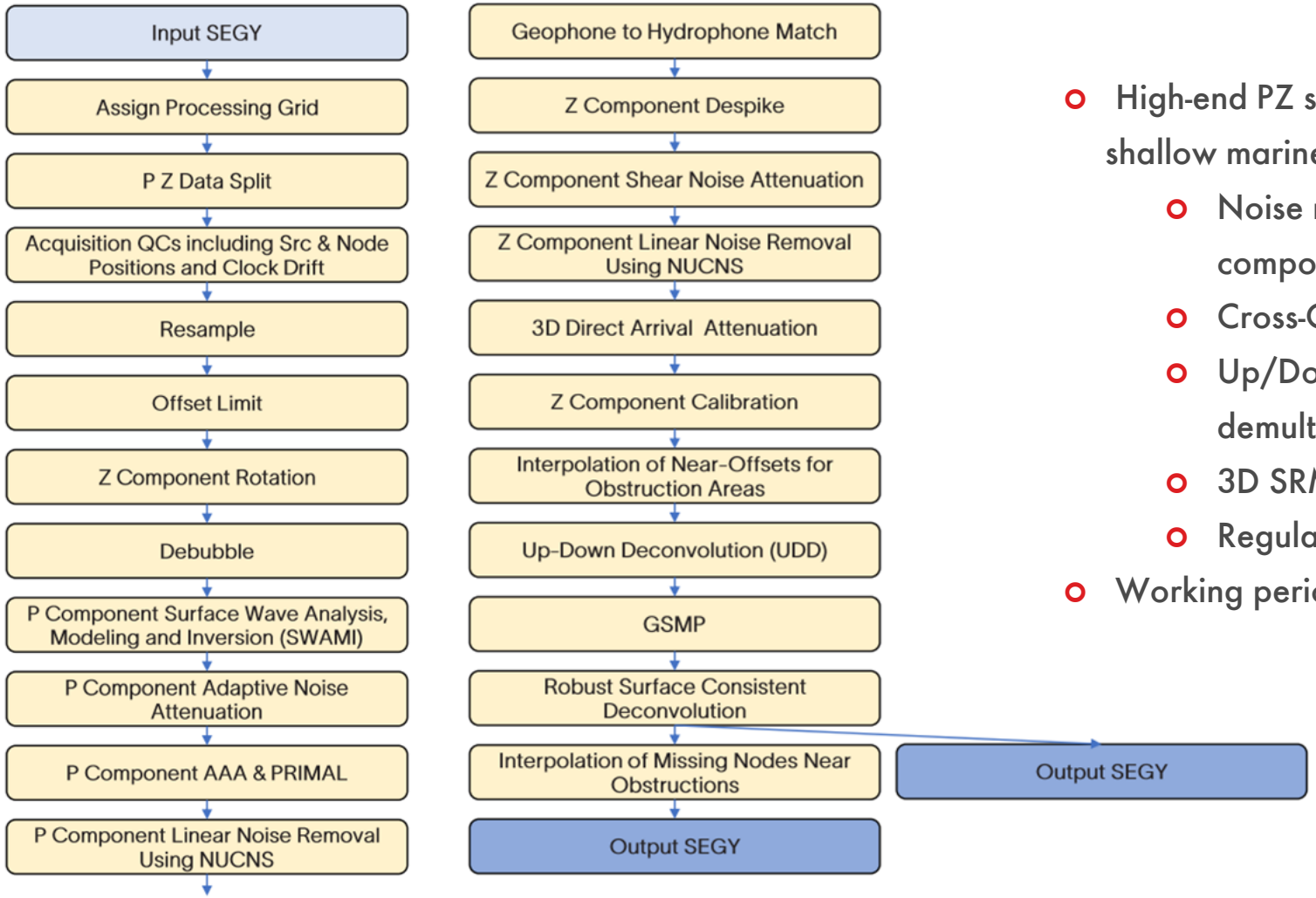


Timeline for SLB pre-processing + Shell Velocity Model Building & Imaging



- Pre-processing carried-out by a Shell-dedicated processing team at SLB in London, UK
- Imaging carried-out in-house at Shell in The Hague

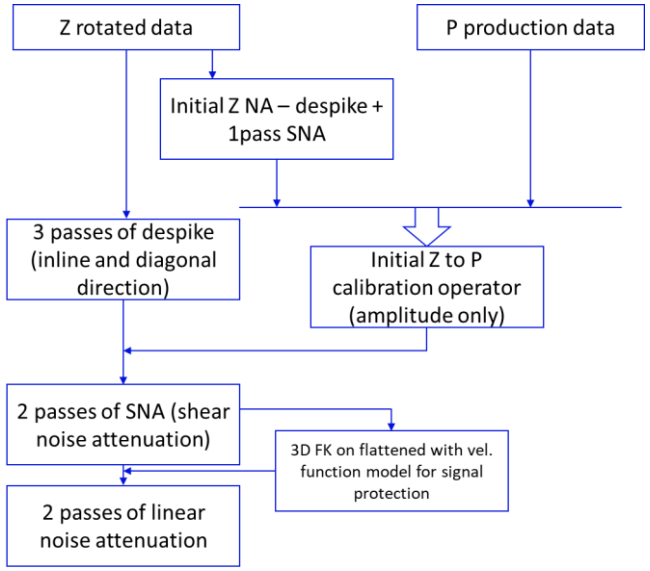
Pre-processing by SLB, London

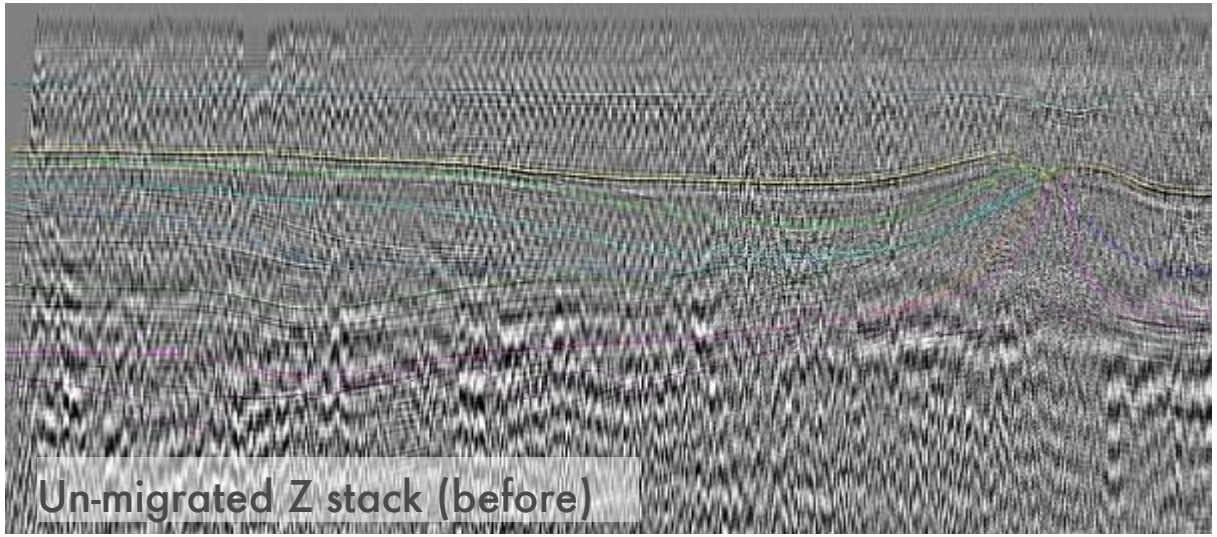


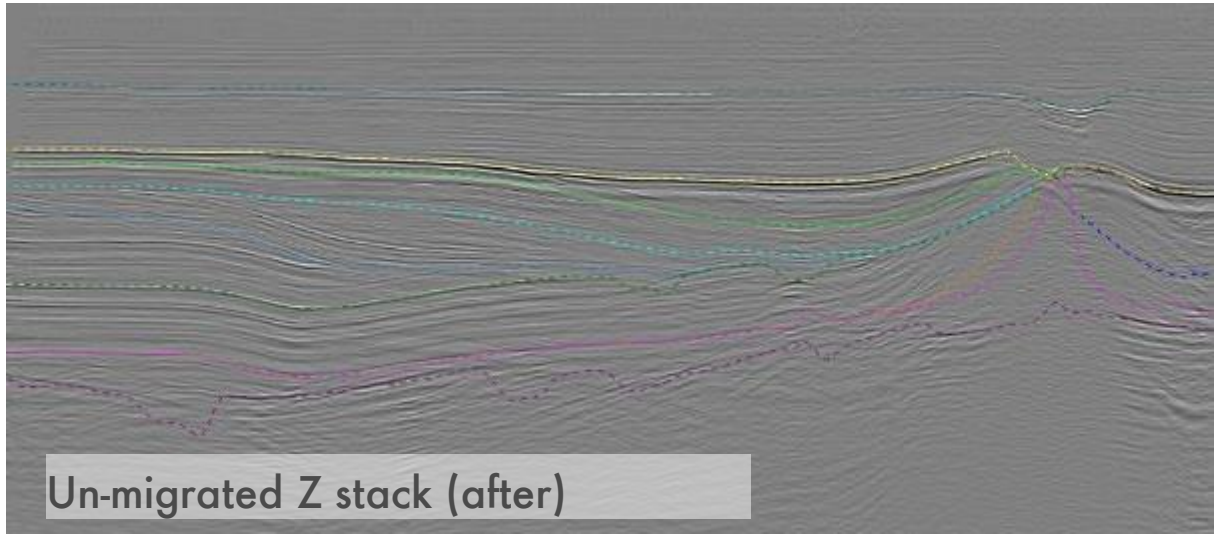
- High-end PZ summation processing workflow designed for shallow marine setting and broadband processing
  - Noise removal (mud-roll + shear noise) from Z component
  - Cross-Ghosting for optimal PZ calibration
  - Up/Down Decon for deghosting and short period demultiple (UDD)
  - 3D SRME for long period demultiple (GSMP)
  - Regularization to reduce impact of gaps in coverage
- Working period: Dec. 2022 – Dec. 2023

Noise removal from Z component

- Up/Down Decon (UDD) is the most critical part of the pre-processing and handles zero-phasing, deghosting and short-period demultiple.
- However this requires the Z component to be denoised and matched to the P component, which is technically challenging.
- The final workflow makes heavy use of SLB's SNA process, which uses the denoised P component as a reference to identify signal on the Z.

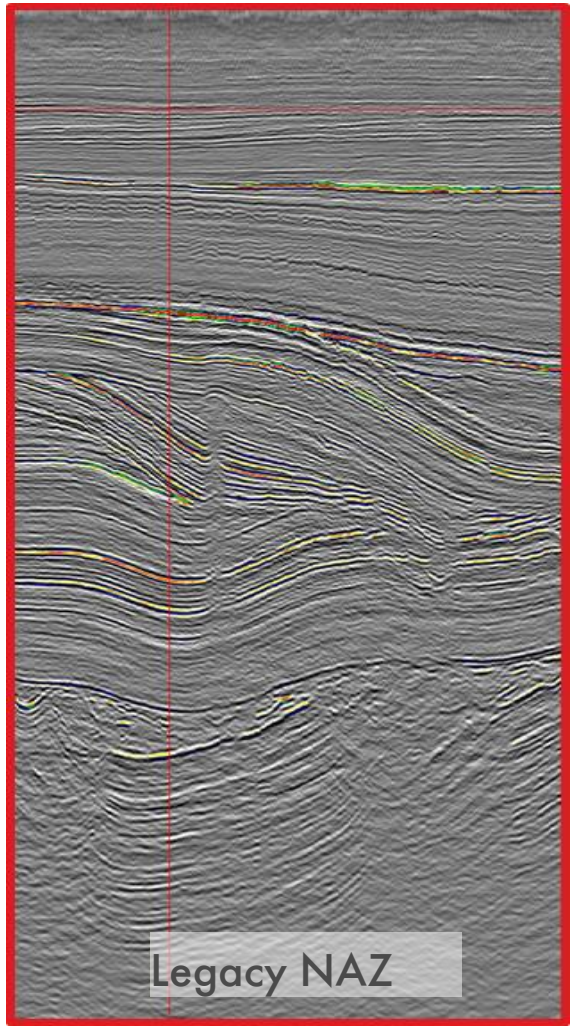


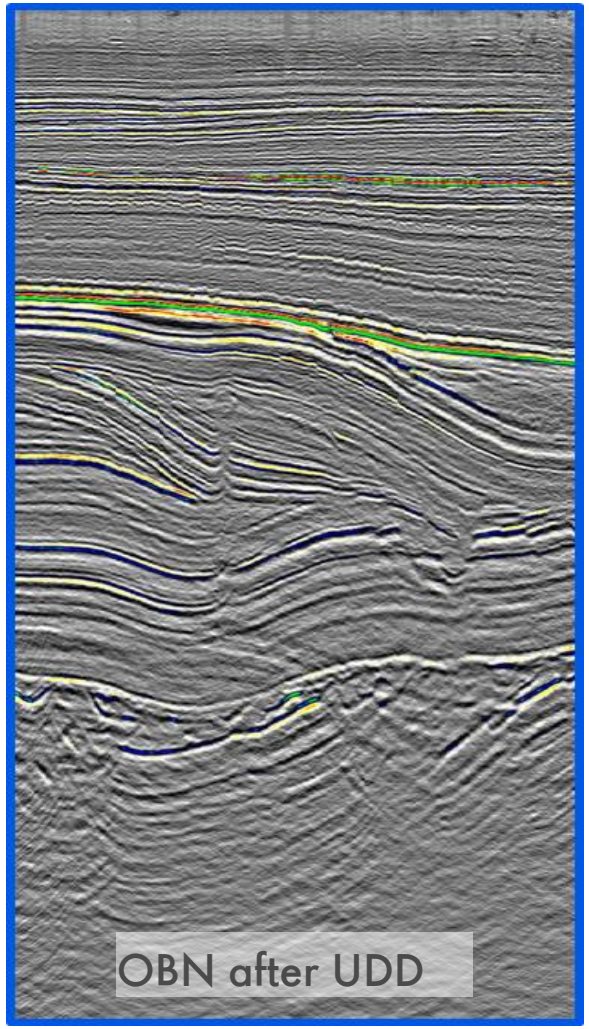


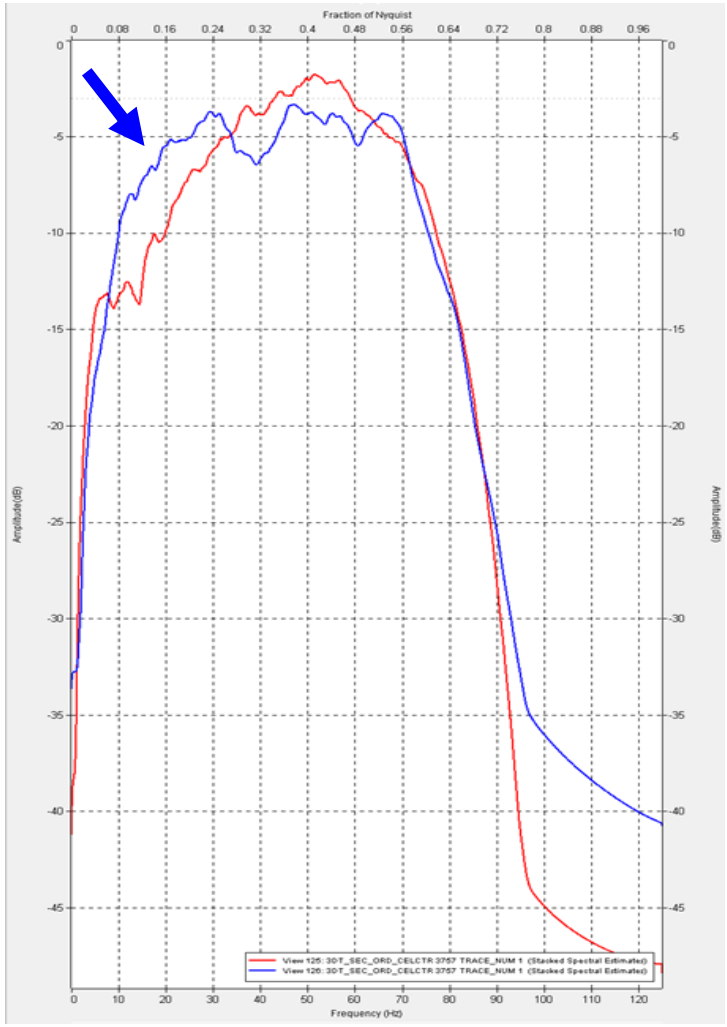


Images courtesy of SLB

OBN broadband processing: rich in low and high frequencies



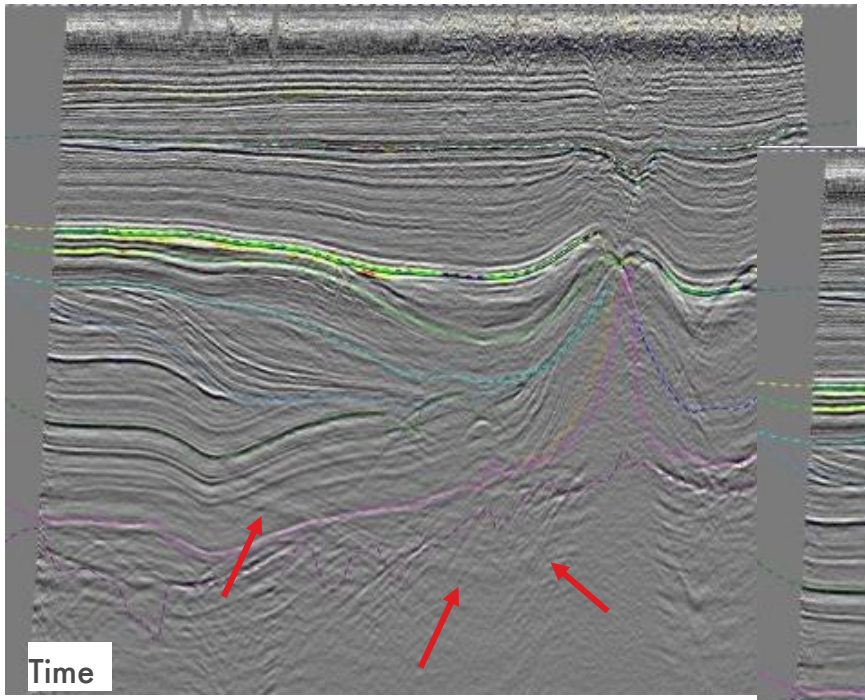




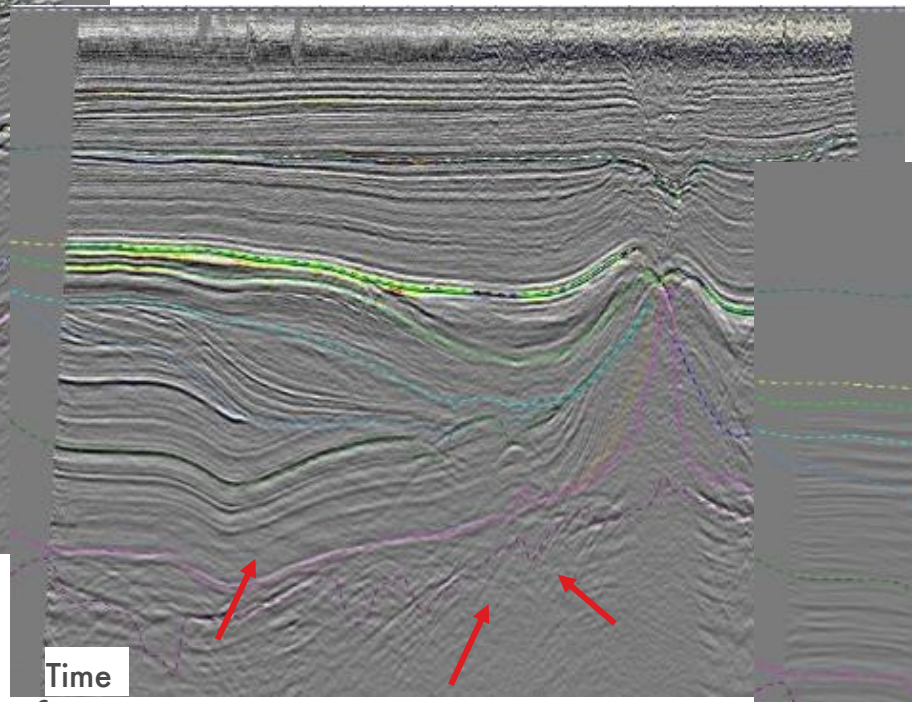
Images courtesy of SLB

3D SRME: E-W line, PZ stack before migration

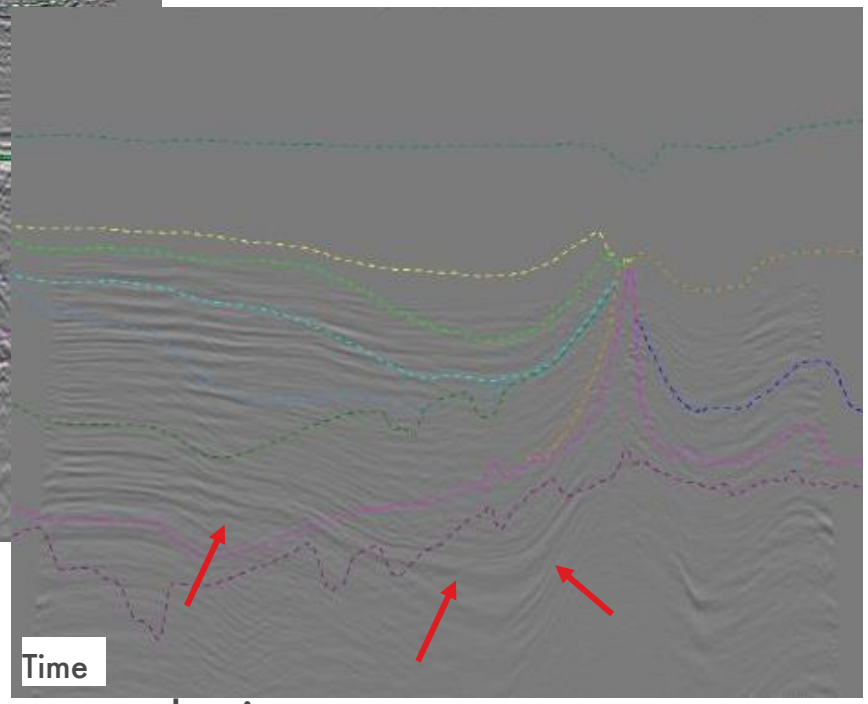
UDD effectively removes short period multiple but SRME is required for longer period multiples.



before



after

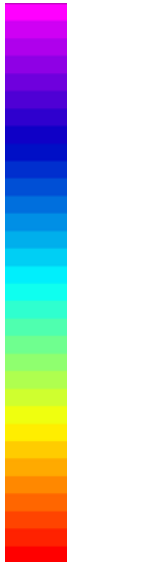


removed noise

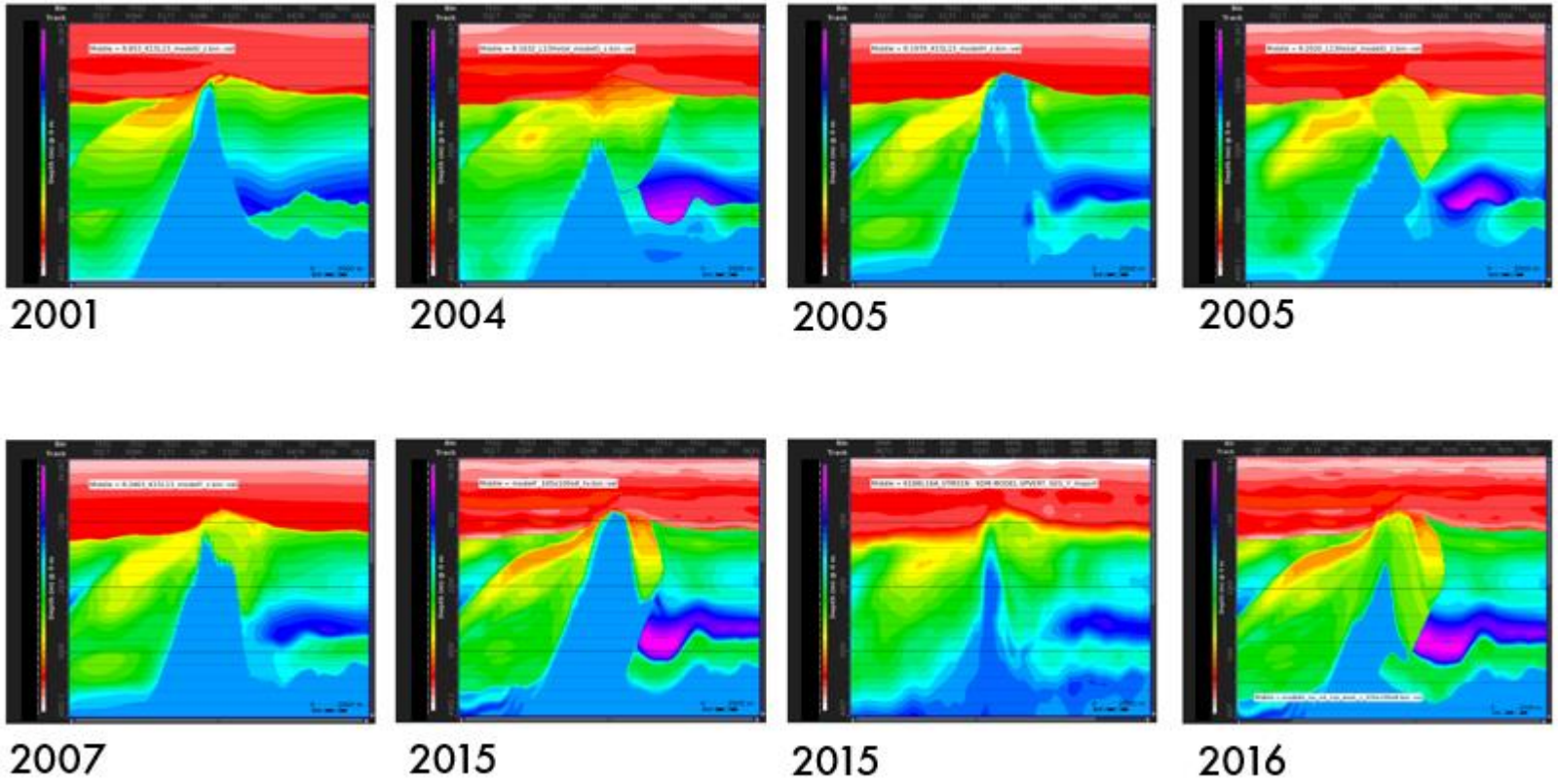
Images courtesy of SLB

20+ years of 3D NAZ-based seismic velocity model building

High velocity

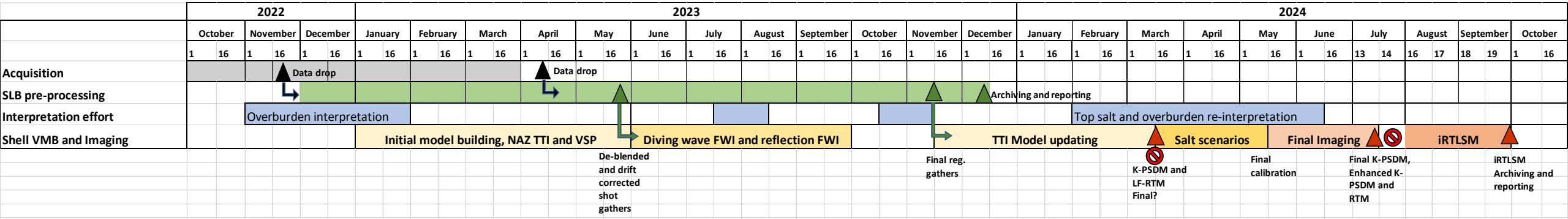


Low velocity



- 20+ years of seismic imaging efforts using many NAZ streamer surveys
- Uncertainty of Chalk, Salt and Anhydrite geometries + velocities impact the Imaging, illumination and Time to Depth conversion of the reservoir sands

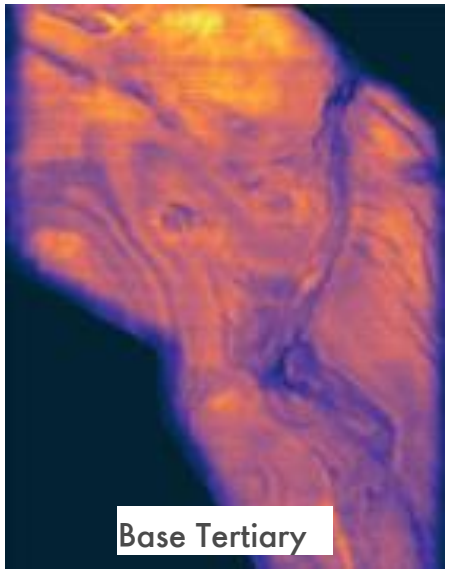
Velocity model building & imaging workflows: key components

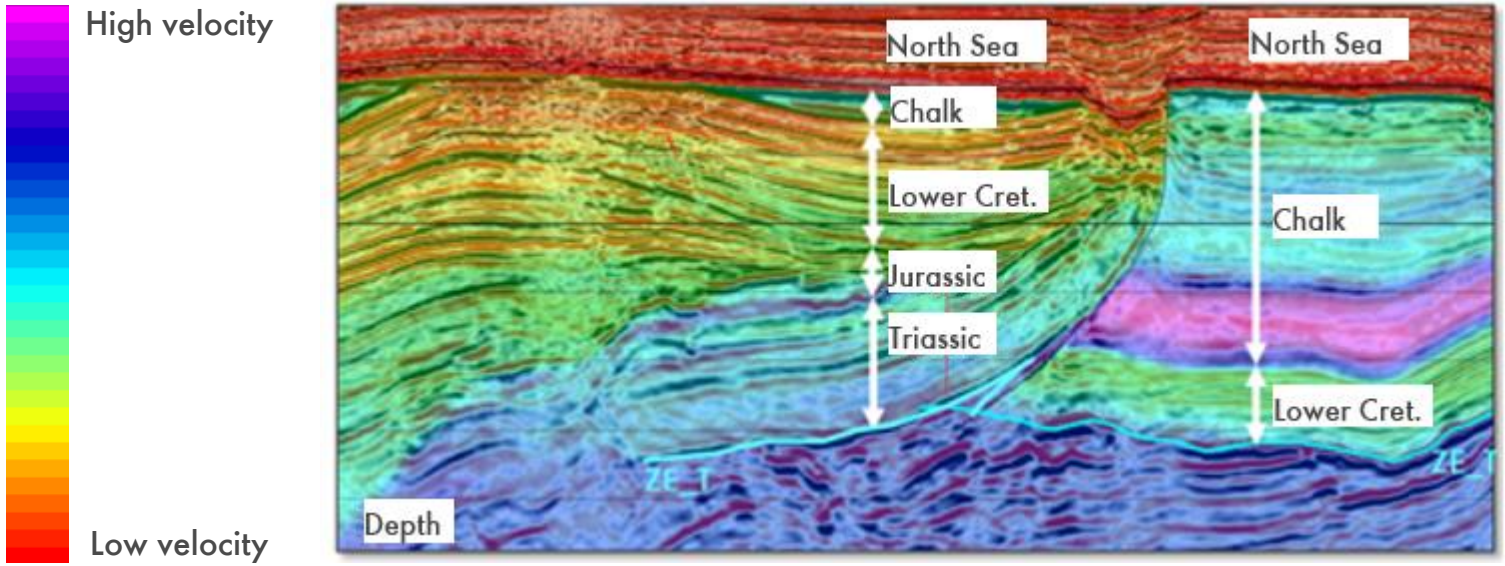


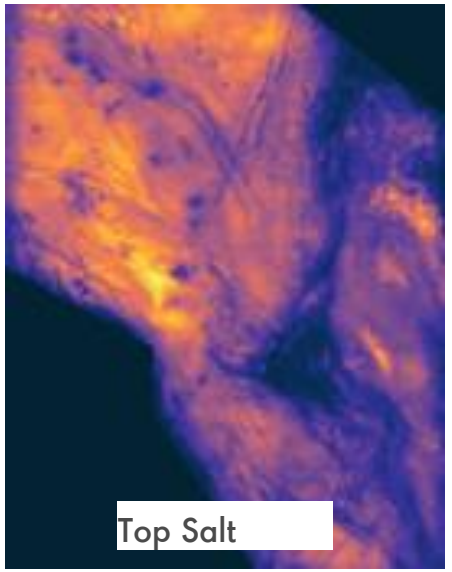
- Initial (calibrated) model building using merged horizons, well markers and 80+ sonic logs
- Close collaboration between WINZ, EBN and NAM to drive the initial model building and re-calibration efforts
- Interpretation of multiple events and QC against well-tops
- Multi-azimuth based Travel Time Tomography inversion of the available NAZ streamer datasets to prepare the model for FWI
- Diving wave FWI and reflection FWI utilizing the long offsets and very low frequencies
- WAZ based Travel Time Tomography Inversions to update the overburden sediments and reduce the overall residual move-out
- Interpretative driven Salt scenario floading to achieve the optimal Top Salt accompanied by iterative Base Chalk Interpretations
- Re-calibration of final model
- Imaging: RTM, Enhanced Kirchhoff, 45Hz Iterative Least Squares RTM

Complex geology driving the model building choices

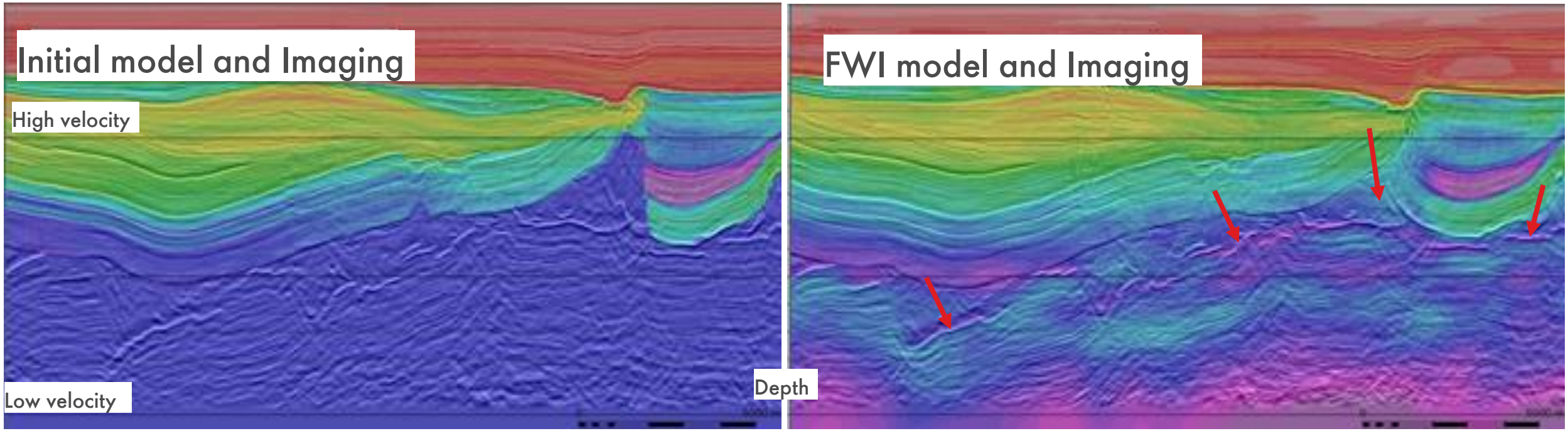
- East/West geological differences seperated by a North-South Salt ridge/thrust
- Salt domes, ‘salt wall’ and overhangs
- Very high velocity chalk build-ups east of the salt thrust
- Unconformities and pinch-outs





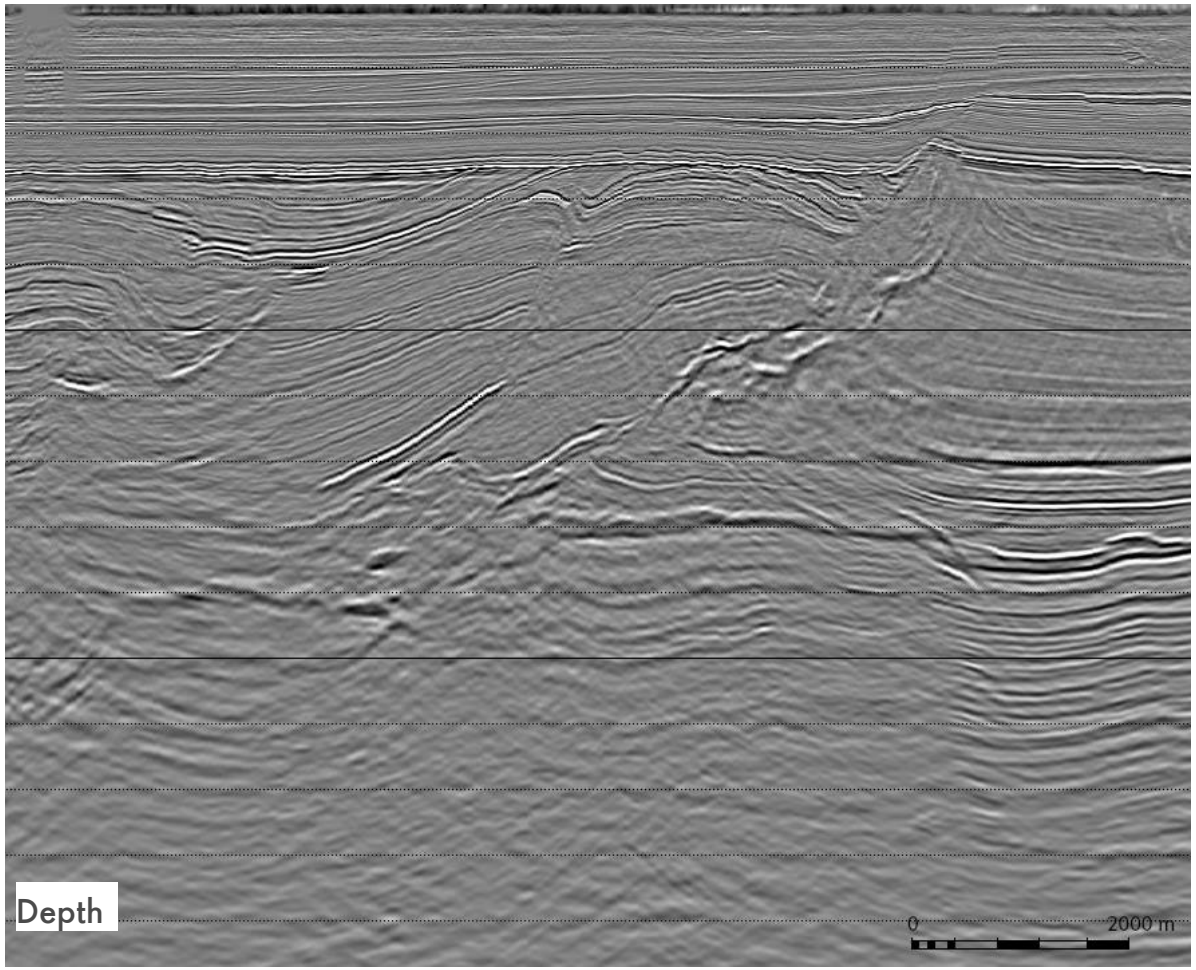


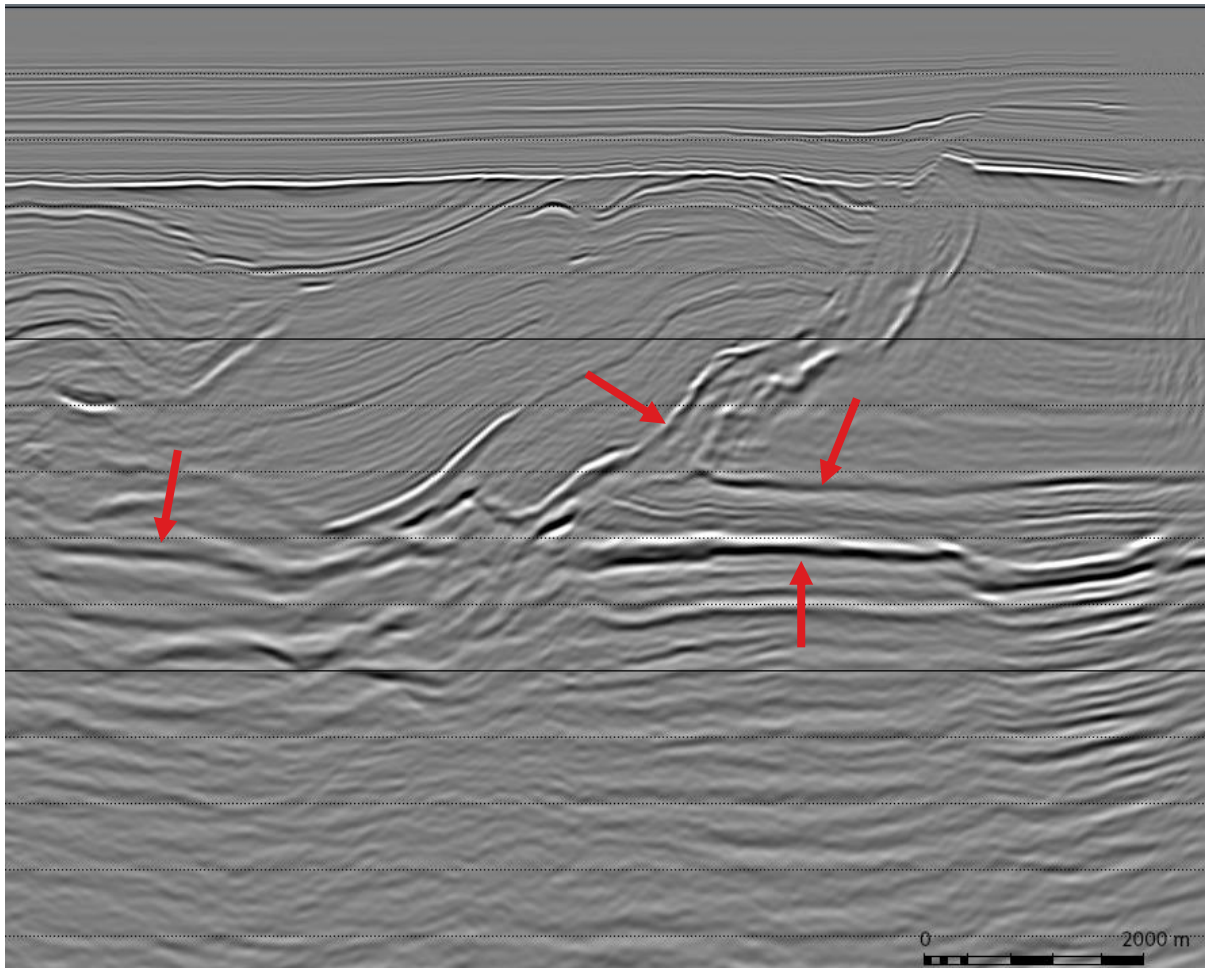
Diving wave FWI and reflection FWI resulting in deep velocity updates



- Available FWI offsets > 9000m + very low frequencies (~2Hz) allows for deep velocity model updates
- FWI: normal streamer acquisitions can only update to Base North Sea due to limited maximum offset

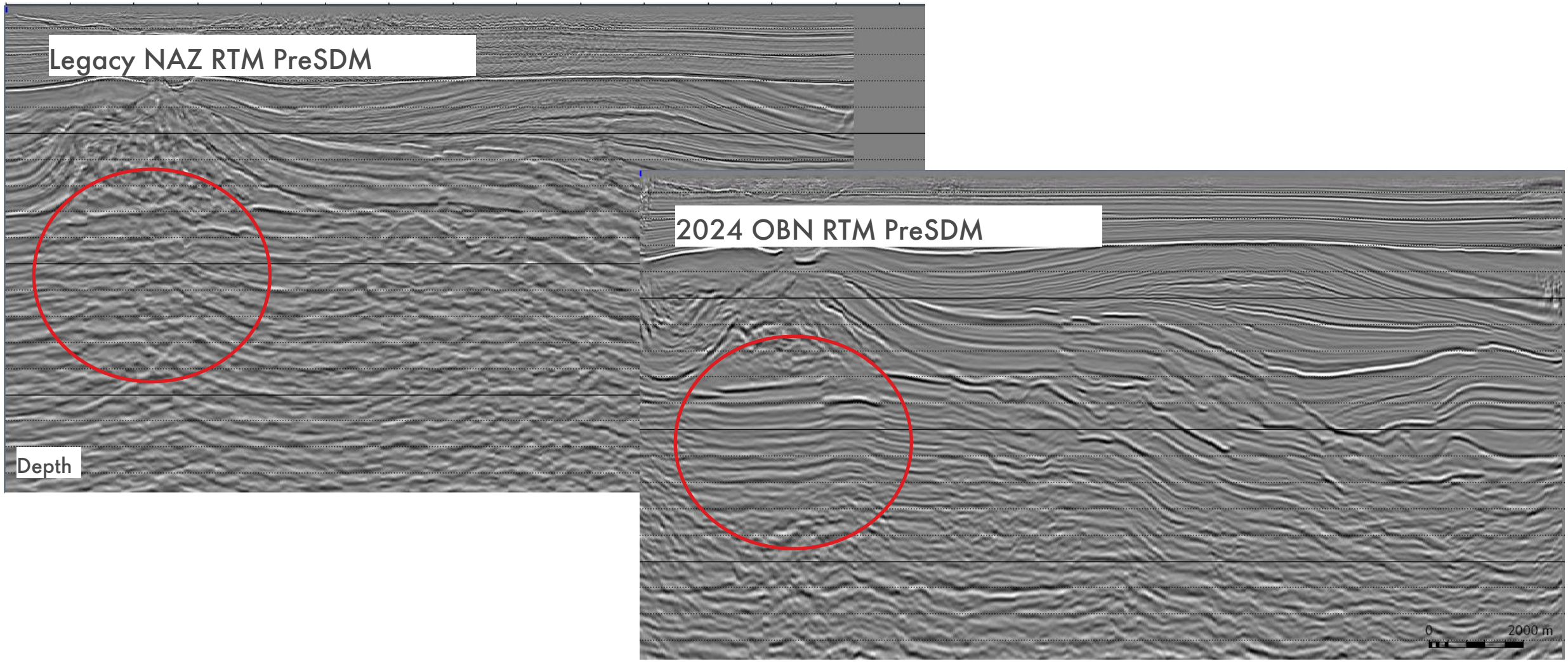
Legacy NAZ Kirchhoff PreSDM (left) versus 2024 OBN RTM PreSDM (right)



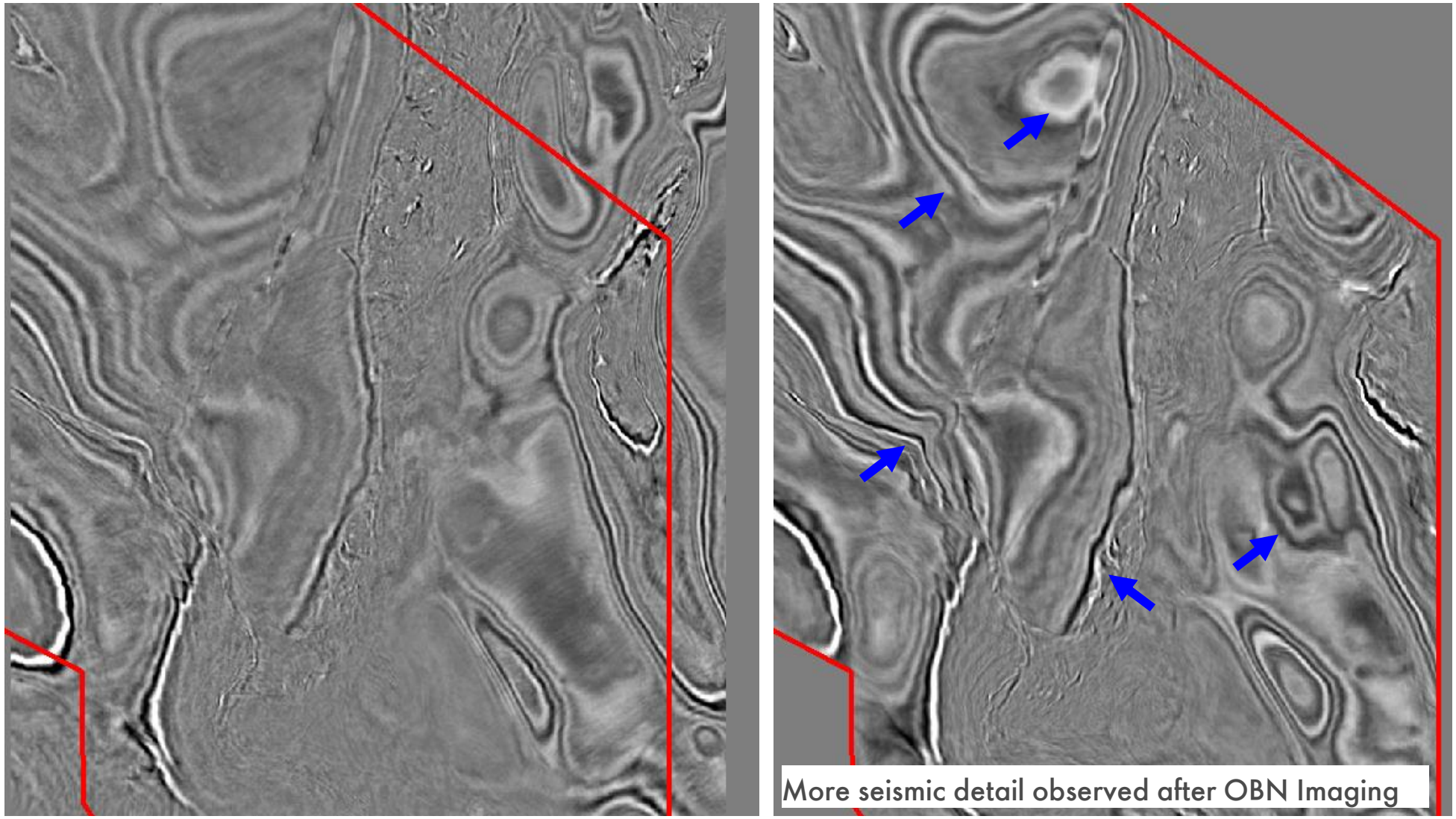


Impact of low frequencies for deep Imaging of the thrust and below

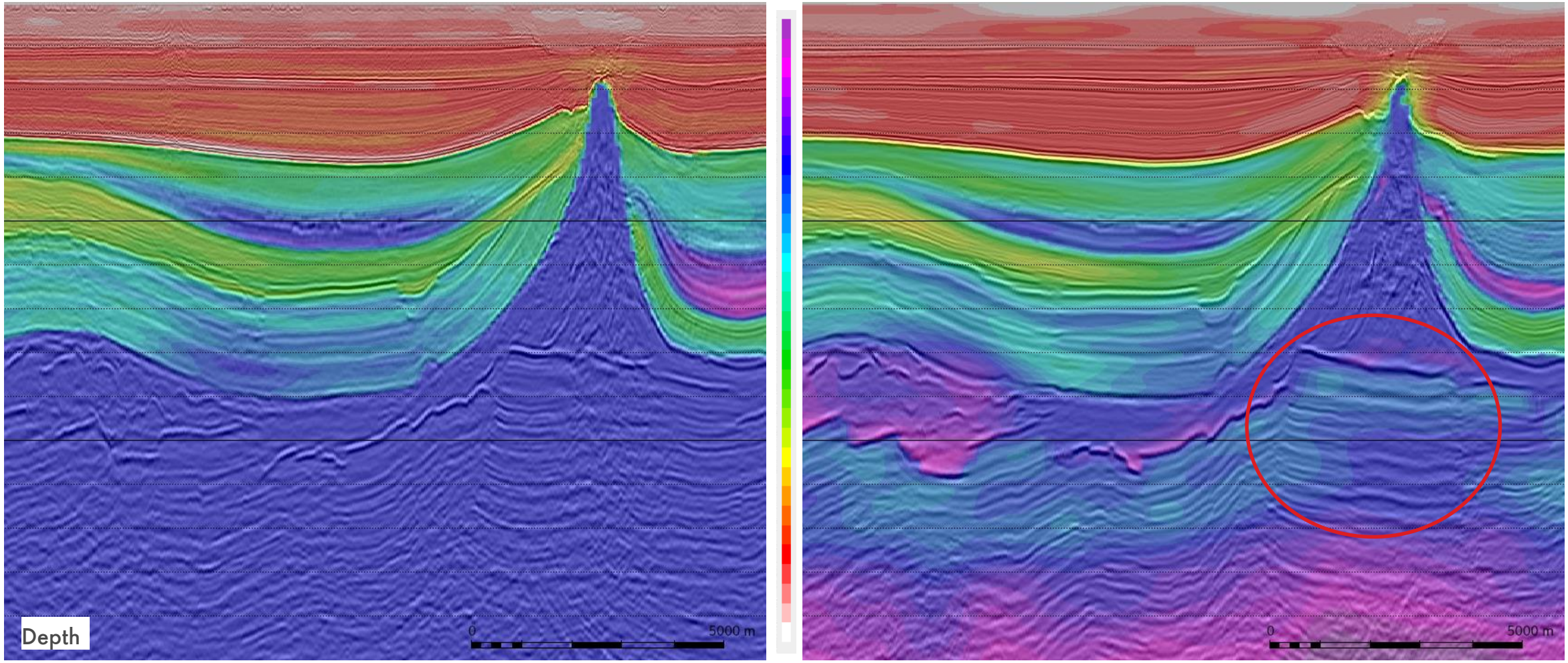
Improved Imaging below Salt



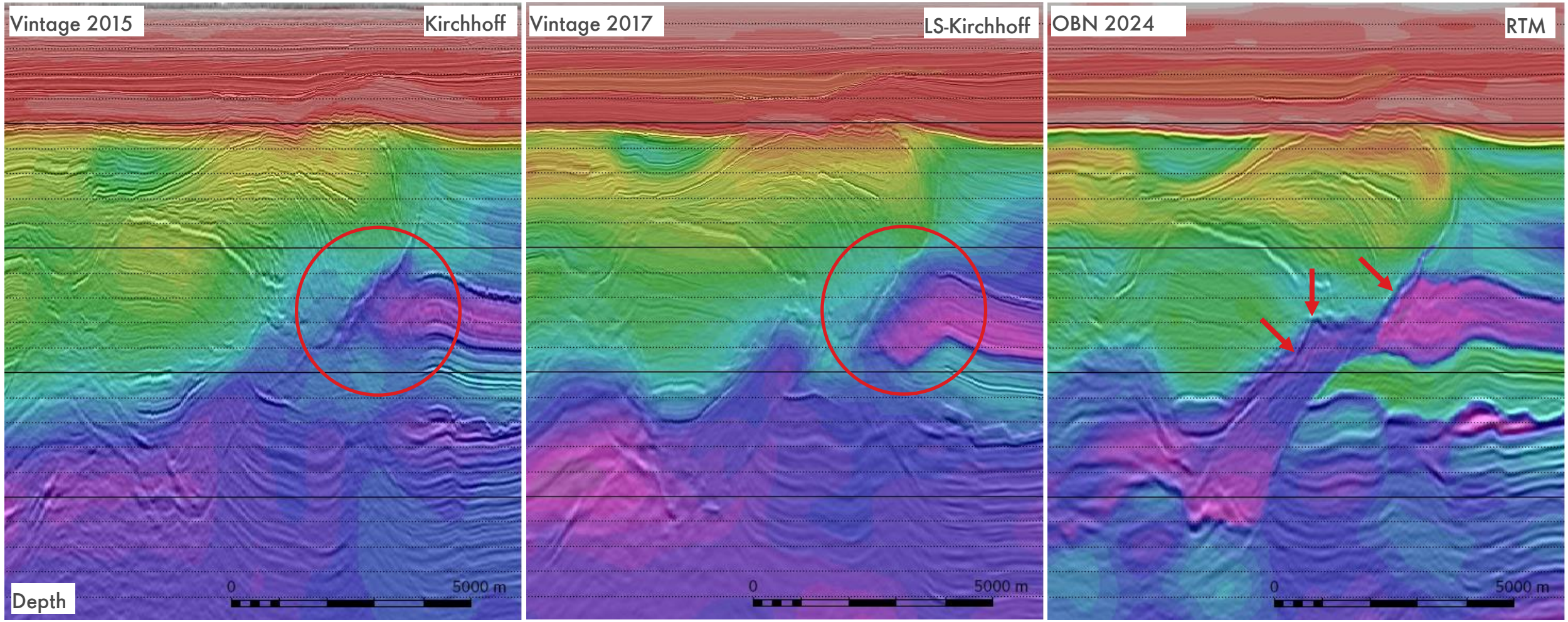
Legacy RTM PreSDM (left) versus 2024 OBN RTM PreSDM (right): 3700m



Legacy NAZ RTM PreSDM (left) versus 2024 OBN LSRTM PreSDM (right)

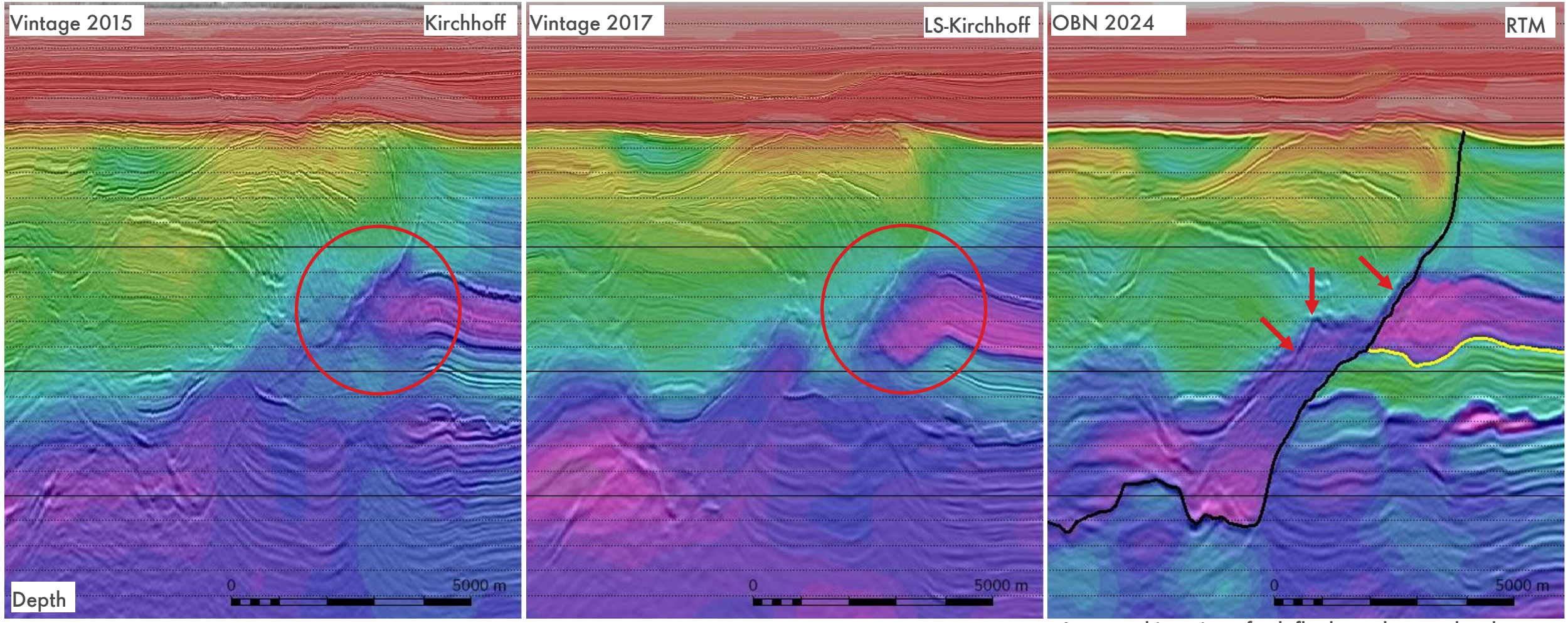


Legacy versus OBN: fast chalk and salt (geometric) velocity differences impacting imaging underneath and T2D



Improved imaging of salt flanks and target level

Legacy versus OBN: fast chalk and salt (geometric) velocity differences impacting imaging underneath and T2D



Improved imaging of salt flanks and target level

Summary

- The OBN acquisition successfully delivered broadband, WAZ, high fold and long offset data
- Focus on maintaining data integrity and highest HSSE standards in the face of operational challenges (principaly due to the requirement of shooting seismic outside the summer season)

- Successfull specific OBN pre-processing resulted in (multiple-free) broadband signal and excellent base for model building and Imaging
- Improved Imaging and T2D compared to vintage processing work due to:
  - Diving FWI and Reflection FWI given the available long offsets and low frequencies
  - Traveltime Tomography Inversion and Interpretative driven Top salt scenario Imaging
  - Velocity model calibration
  - High. freq. intermediate RTM's and LSRTM Imaging
  - More reliable amplitudes due to iterative LSRTM – potential to produce seismically-derived reservoir properties

- Key for success was the efficient collaboration between Wintershall, EBN, NAM and Shell

Acknowledgments: EBN, NAM, Wintershall, Rock-Rose Energy, One-Dyas, Shell, Shearwater Geoservices & SLB

Sabine Korevaar	EBN
Johannes Rehling	EBN
Bas van der Es	EBN
Cees Van Eden	Shell
Jeroen Goudswaard	Shell
Xander Campman	Shell
Dhwajal Chavan	Shell
Dan Bright	Shell
Frans Smit	Shell
Jeroen Beishuizen	Shell
Juan Pi Alperin	Shell
Martin Dvorak	Shell
Ron Verrijp	Shell
Yuriy Aleksakhin	Wintershall
Marc Beller	Wintershall
SWGS marine crew and office support	Shearwater GeoServices
Galina Miasnikova, Federico Sokolowski and the SLB dedicated processing team for Shell	SLB
Katherine Ryan and subsea team	NAM
Klaas Bos	NAM
Sjouke de Boer	NAM
Hans Ardesch	NAM
Karel Bokhorst	NAM
Rob Wervelman	NAM
Abdullah Hamood	NAM
Paul Reemst	NAM
Raoul Quadvlieg	NAM
David Nunumete	NAM
Yvan Charreyron	NAM