

The background of the slide is a photograph of a large blue and white seismic survey ship sailing on the ocean. In the upper left, there is a tilted rectangular inset showing a seismic data visualization with yellow and grey patterns and a blue line. The title text is overlaid on the left side of the image.

The diary of a seismic survey: going around in circles in the SNS

Nick Hall, Bert Clever, Simon Lunn

Where does our story take place?

hansa

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Legend



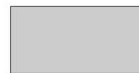
Prospects



Fields



4Quads Licences



Existing 3D



Existing 2D

Sept 2012

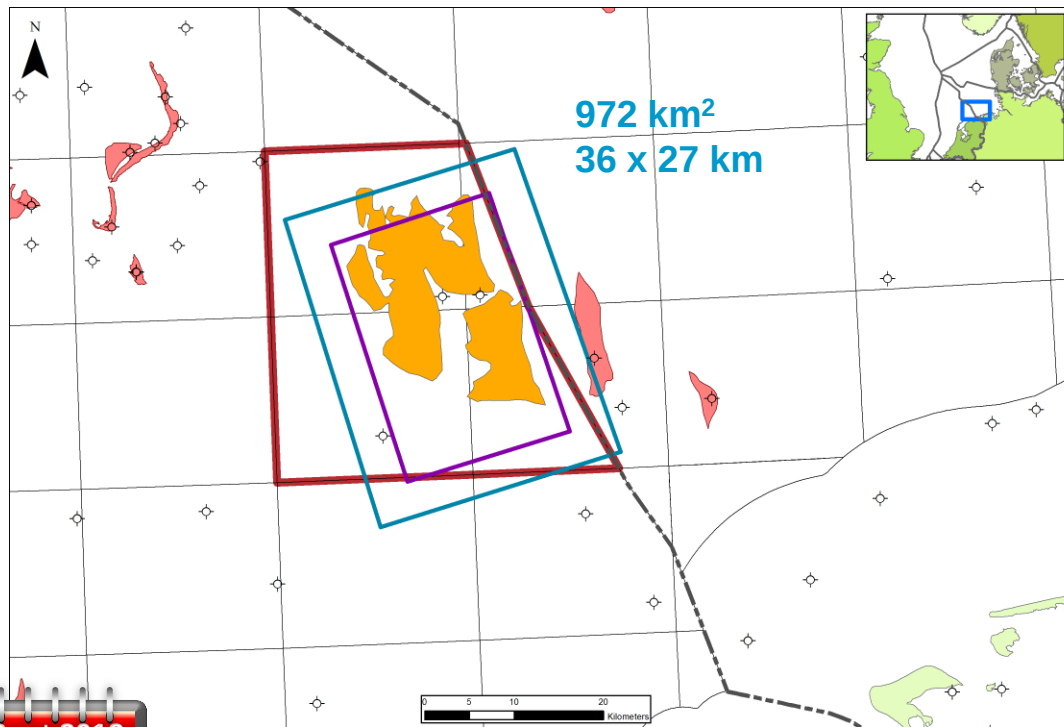
17

4Quads Licences awarded with a work commitment for new 3D seismic.

3D Survey Design

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Legend

-  Fully Migrated 3D
-  Full Fold 3D

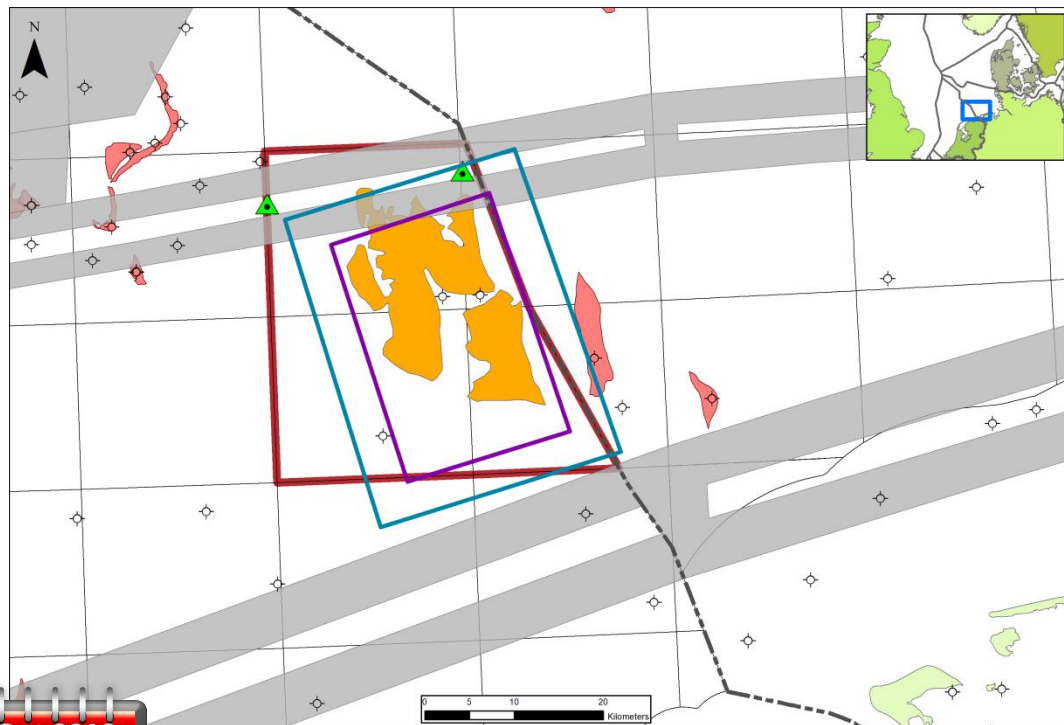


Job done! Bonus promised...

Shipping Lanes

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Legend



Shipping Lanes



Traffic Separation
Buoys



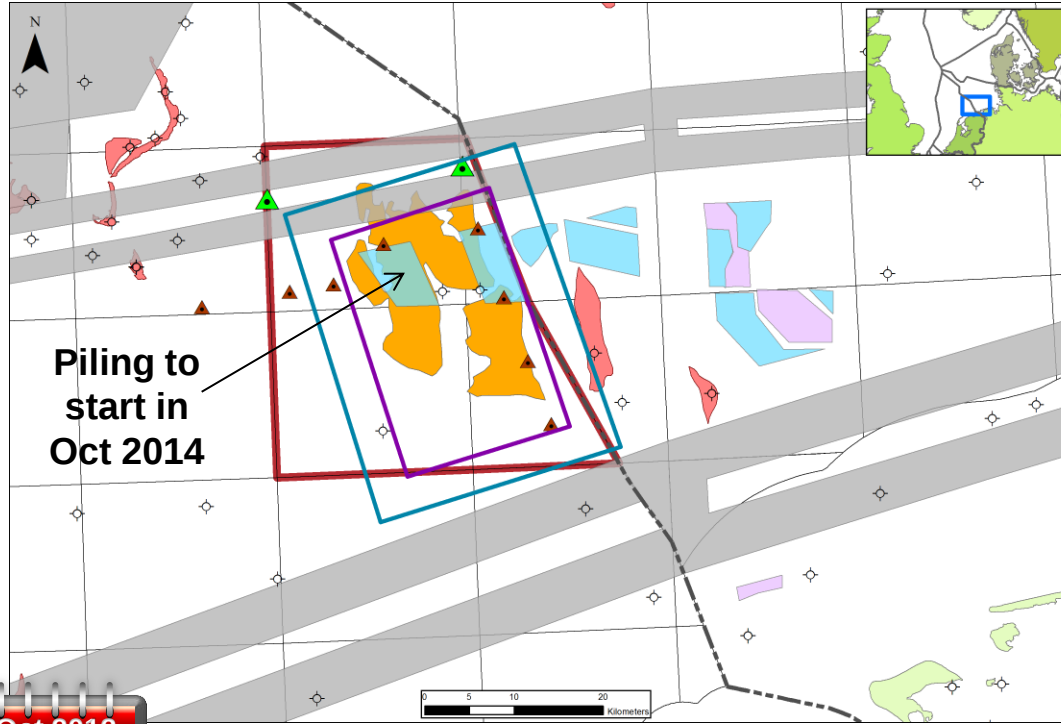
We will definitely need Dutch pilots.



Windfarms

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Legend



Environmental
Monitoring Buoys

Windfarms



Planned



Under Construction /
Online



Planned wind farms everywhere, what about construction noise?

Military Zone

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Legend



Military Zones

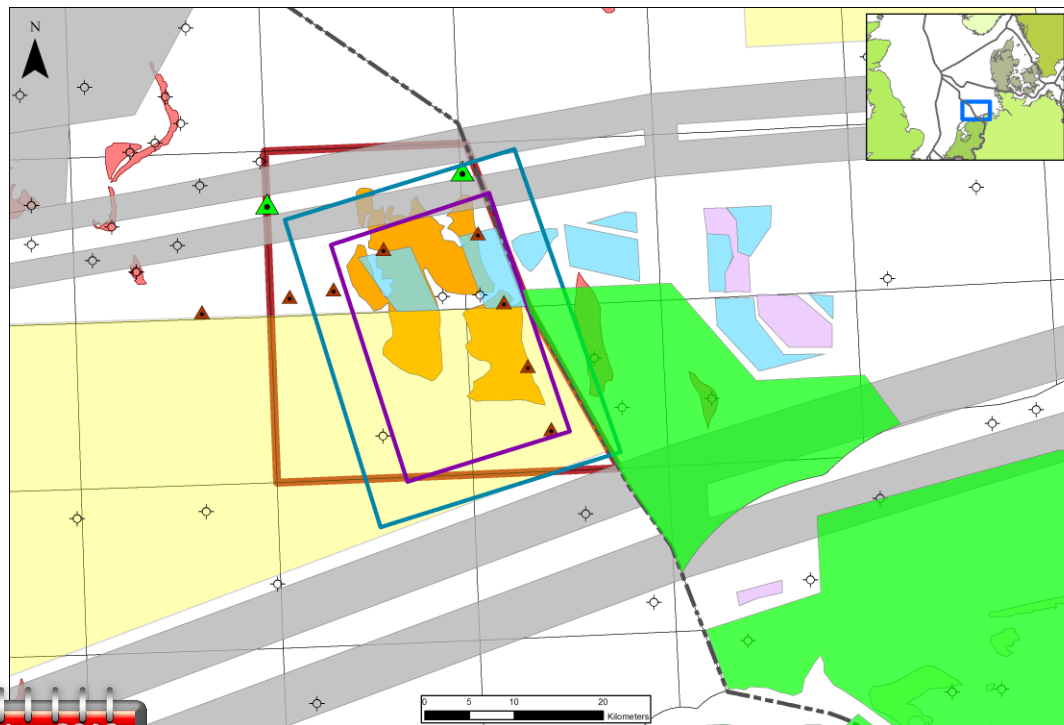


Turns out the Military carry out F16 exercises in the area. We need a permit.

Environmental Areas

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Legend



Natura 2000

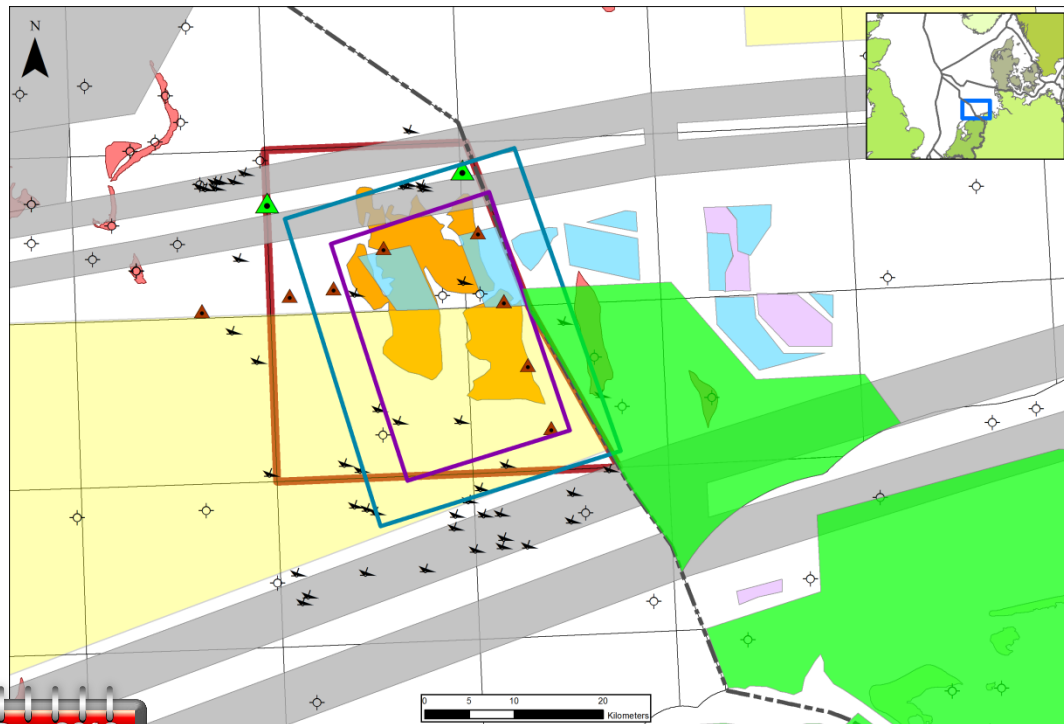


Natura 2000 area next door in Germany - probably won't get a permit there!

Wrecks & Bathymetry

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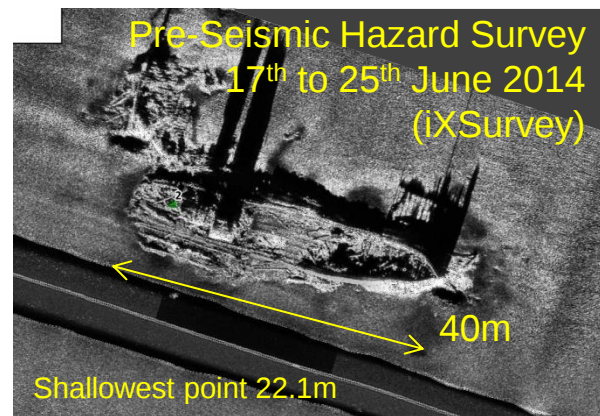
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Legend



Wrecks



Dec 2012

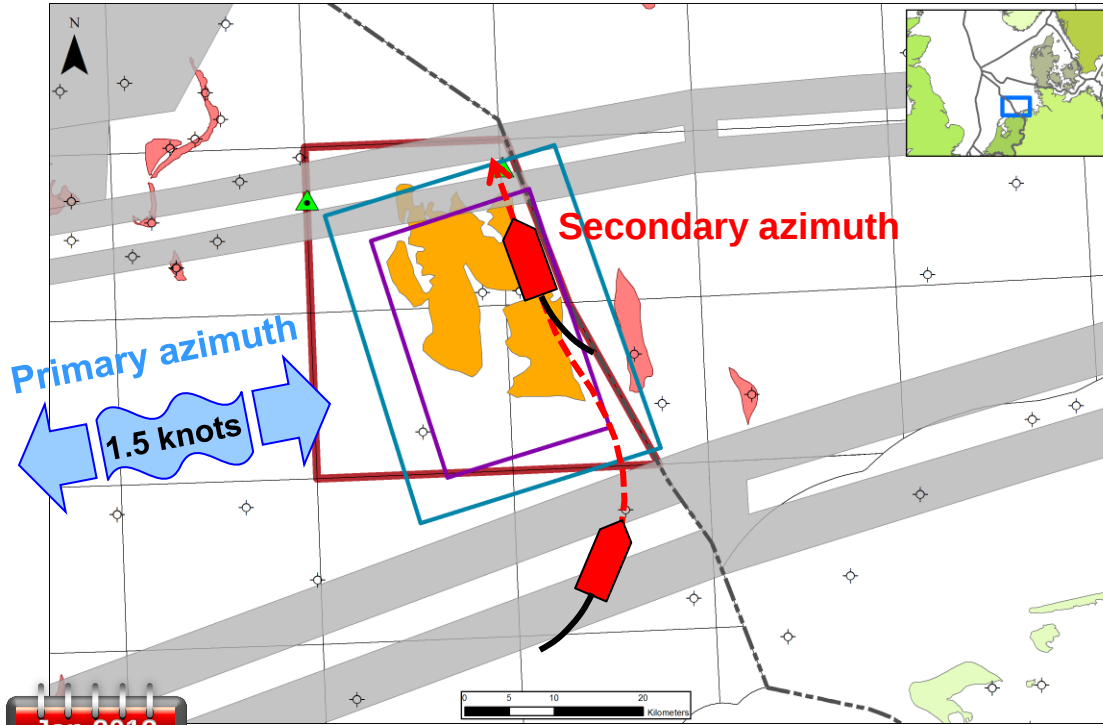
6

Bonus revoked...

3D Survey Design

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Legend

Shipping Lanes

Traffic Separation
Buoys

ITT for conventional survey
+ infill along the median line

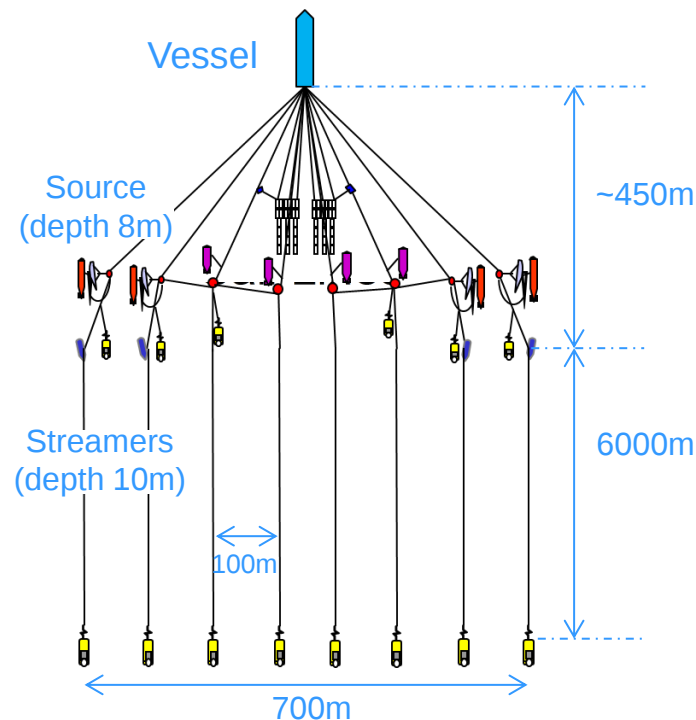
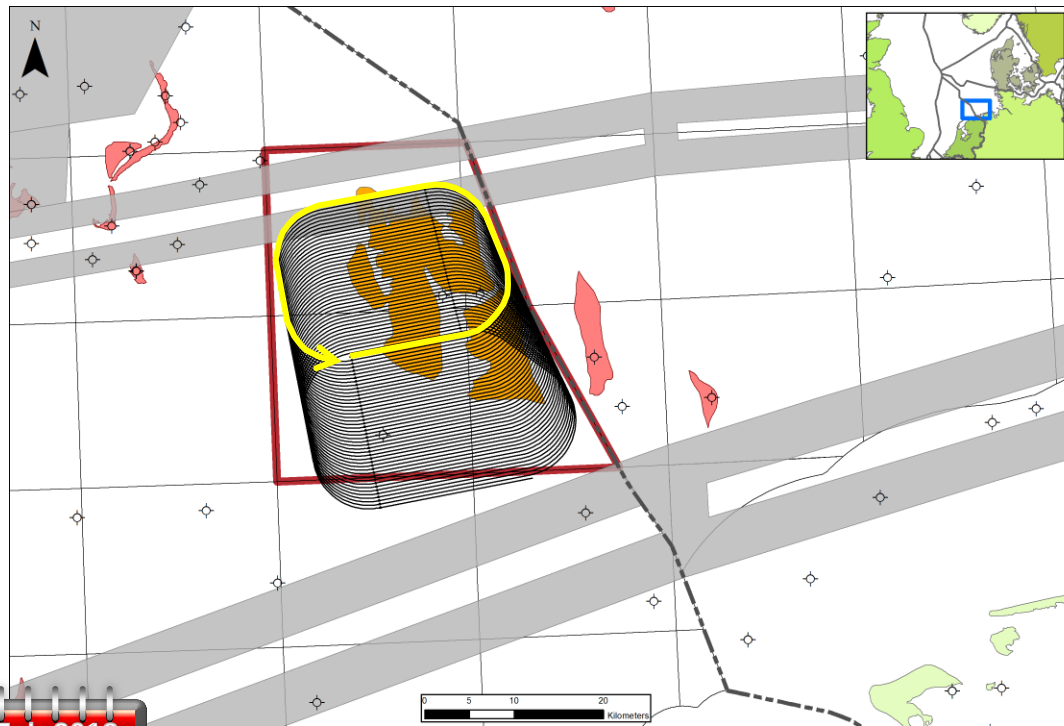


*Concerned about the second azimuth... And the southern shipping lane...
And the shallow water, the tide, feather into Germany...*

Technical Solution

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WesternGeco tender for Continuous Line Acquisition – seems to solve fold and infill issues

Feb 2013

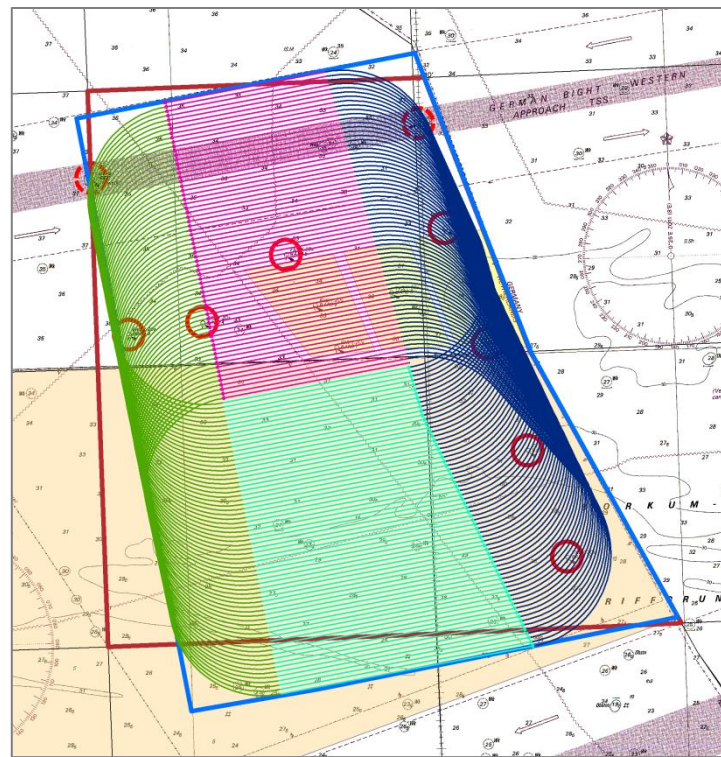
18

Technology Enablers for CLA

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- Q-Marine steerable streamers
- High fidelity streamer positioning
- Single sensor sampling
- Proprietary noise attenuation techniques to remove turn noise
- Other advantages
 - Increased acquisition efficiency
 - Reduced exposure to weather down-time



WesternGeco are preferred contractor for acquisition in July 2013



Some diary excerpts...

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News from Dutch MOD that we can't have a permit for Summer 2013



Contract awarded to WesternGeco for acquisition in Summer 2014



Flora/Fauna & Nature Protection Acts introduced for Dutch offshore – further permits required !



Only 6 weeks to go ! Military permit granted, coastguard will pick-up buoys, pilots organised... But no environmental permits yet !



Permits and exemptions granted. But with conditions...



What are the conditions?

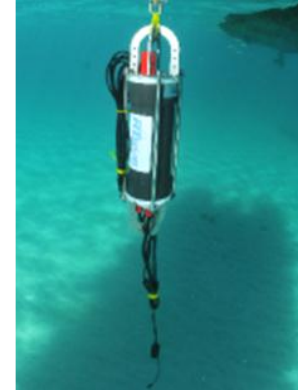
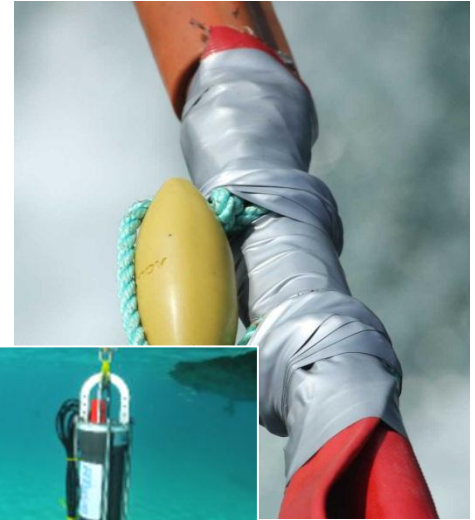
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- Usual requirement for PAM/MMO
- Deploy marine mammal deterrents
- Measure the underwater sound 750m from the seismic source
 - Option 1: boat with hydrophone, switch off engine and record
 - Option 2: place a hydrophone on the sea bed



Or...



Hydrophone
at sea bed

Boom...



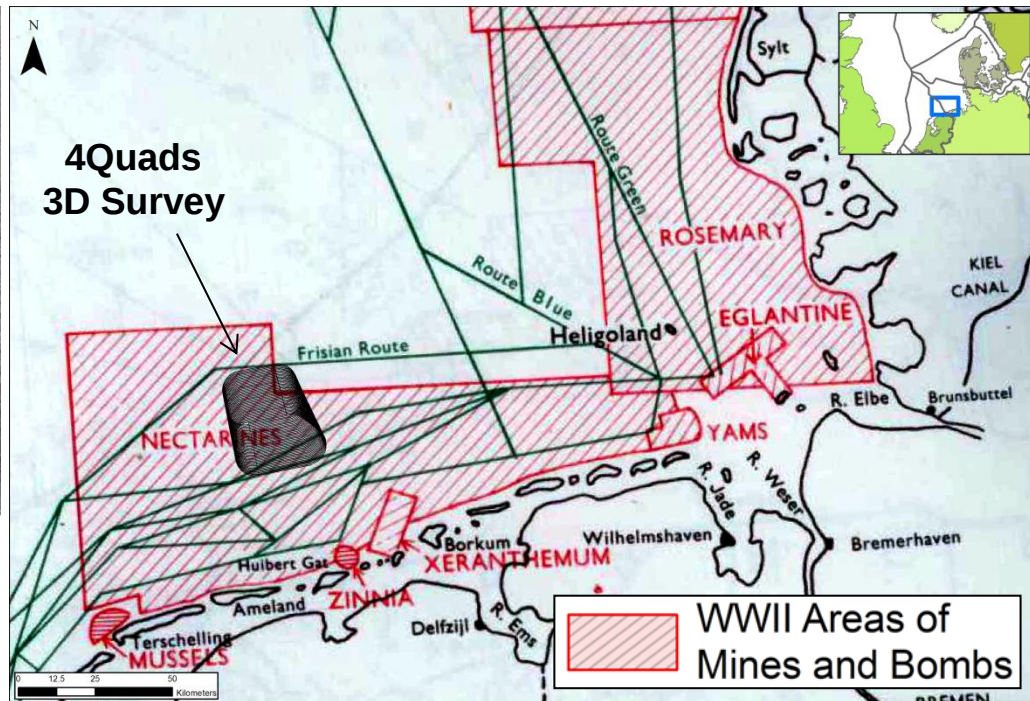
Unexploded Ordnance

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BEAUFIGHTERS ATTACKING A MINESWEEPER OFF BORKUM,
25th August, 1944



Typhoon Energy to the rescue, providing areas cleared of unexploded ordnance. Sea bed hydrophones can be safely deployed.

Jun 2014

12

Some more diary excerpts...

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WG Amundsen mobilised from Shetland Islands



Wind turbine piling in Germany has finished



Acquisition starts in perfect weather conditions



Correction... weather too good. We have a thermocline and navigation acoustics up the spout. Have to reduce source and streamer depths to 6m and 8m.



And here comes Hurricane Bertha!



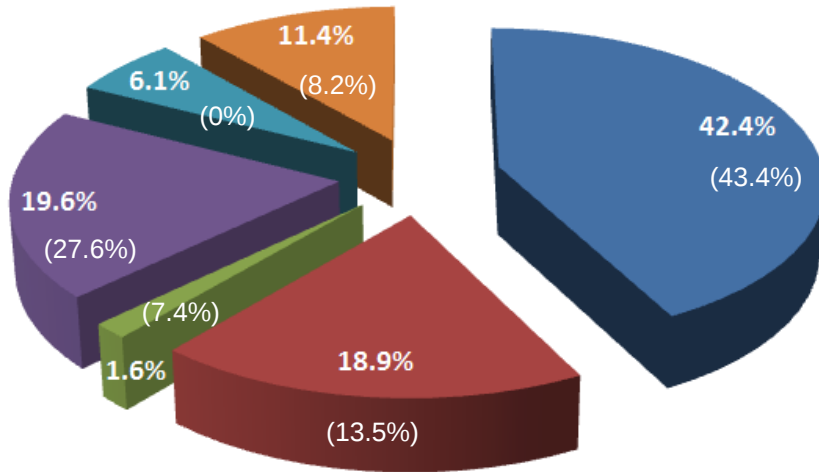
Time Breakdown

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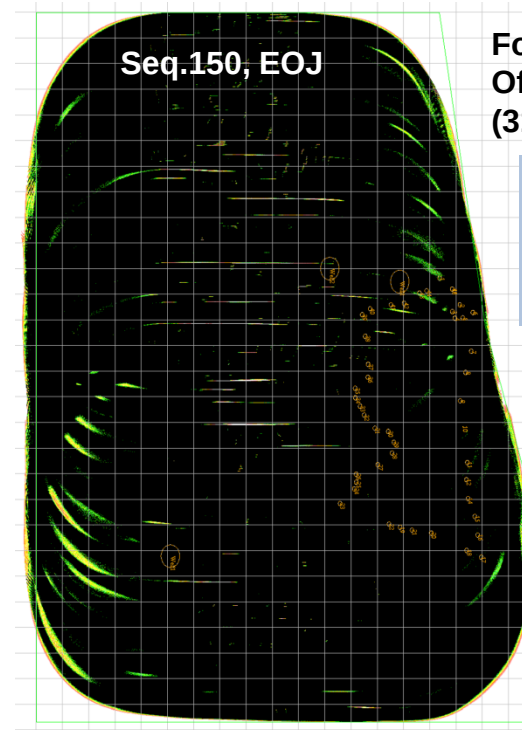
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Actual days: 36.4
(Budget days: 36.7)

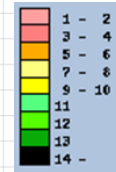
Actual %
(Budget %)



■ Prime acquisition ■ Infill acquisition ■ Technical downtime
■ Weather standby ■ Re-shoot ■ Mob/Demob



Fold of Coverage
Offset Group 3
(3110-4610m)



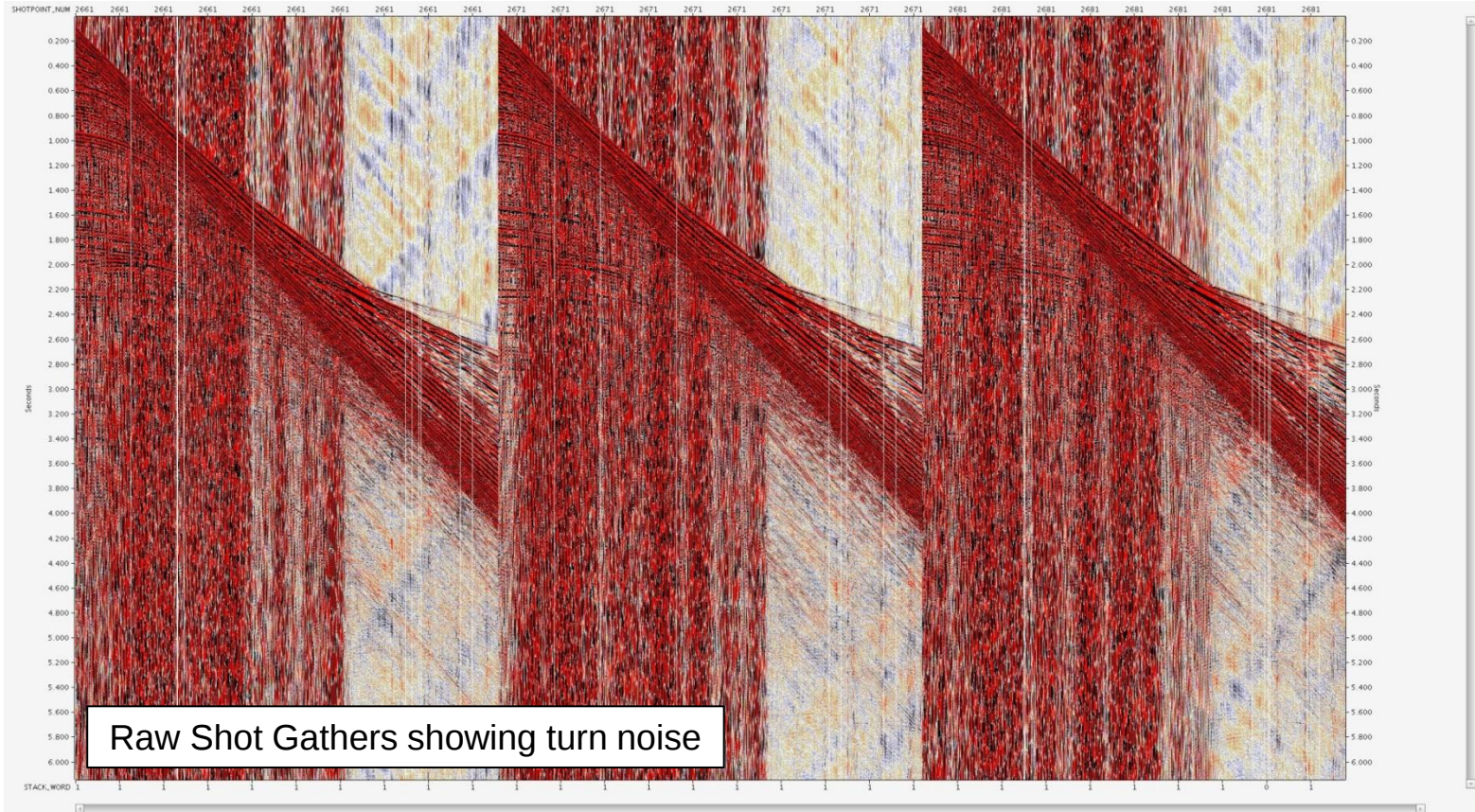
This infill is proving frustrating – budget is running out



On-board Turn Noise Attenuation

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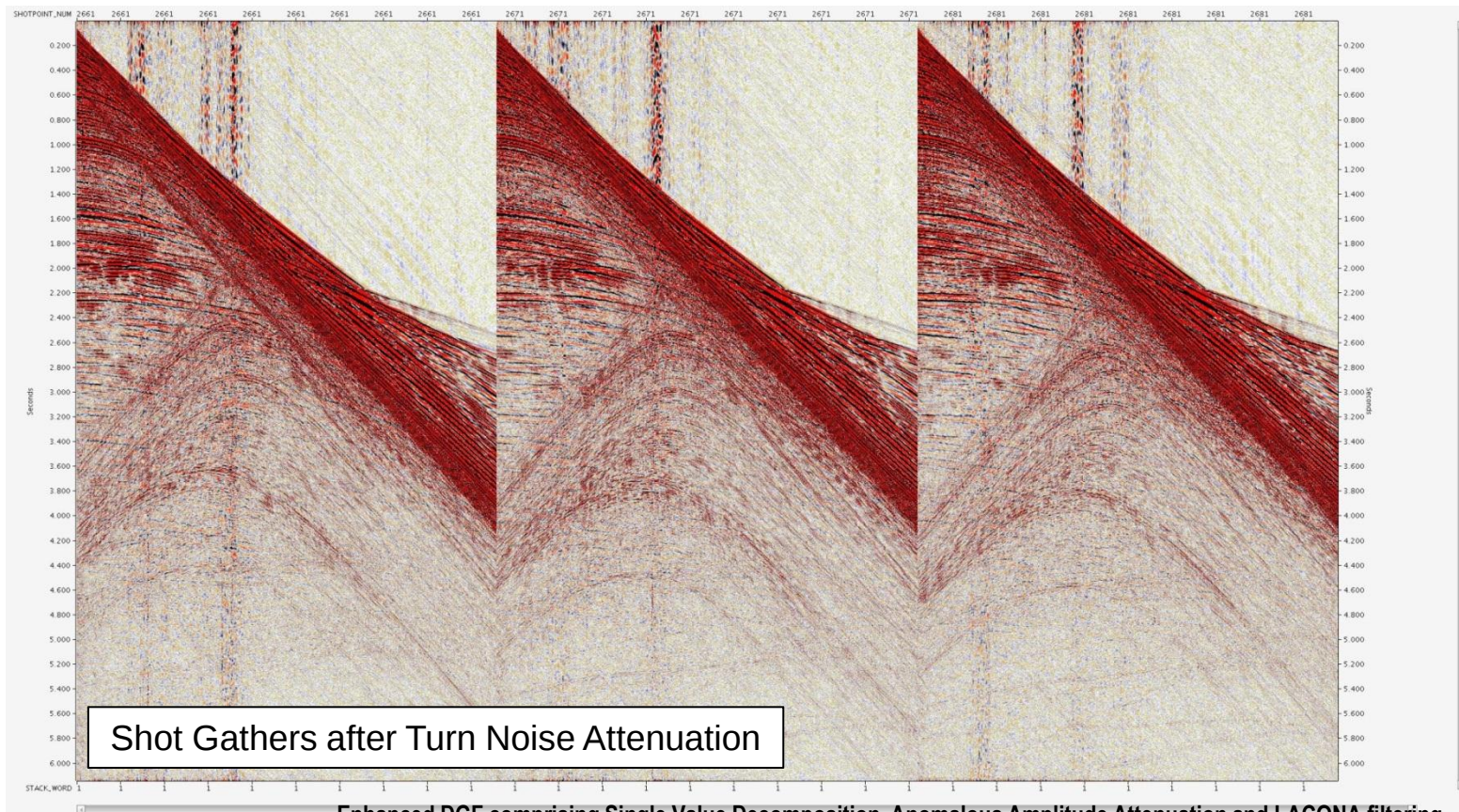
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On-board Turn Noise Attenuation

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Enhanced DGF comprising Single Value Decomposition, Anomalous Amplitude Attenuation and LACONA filtering.

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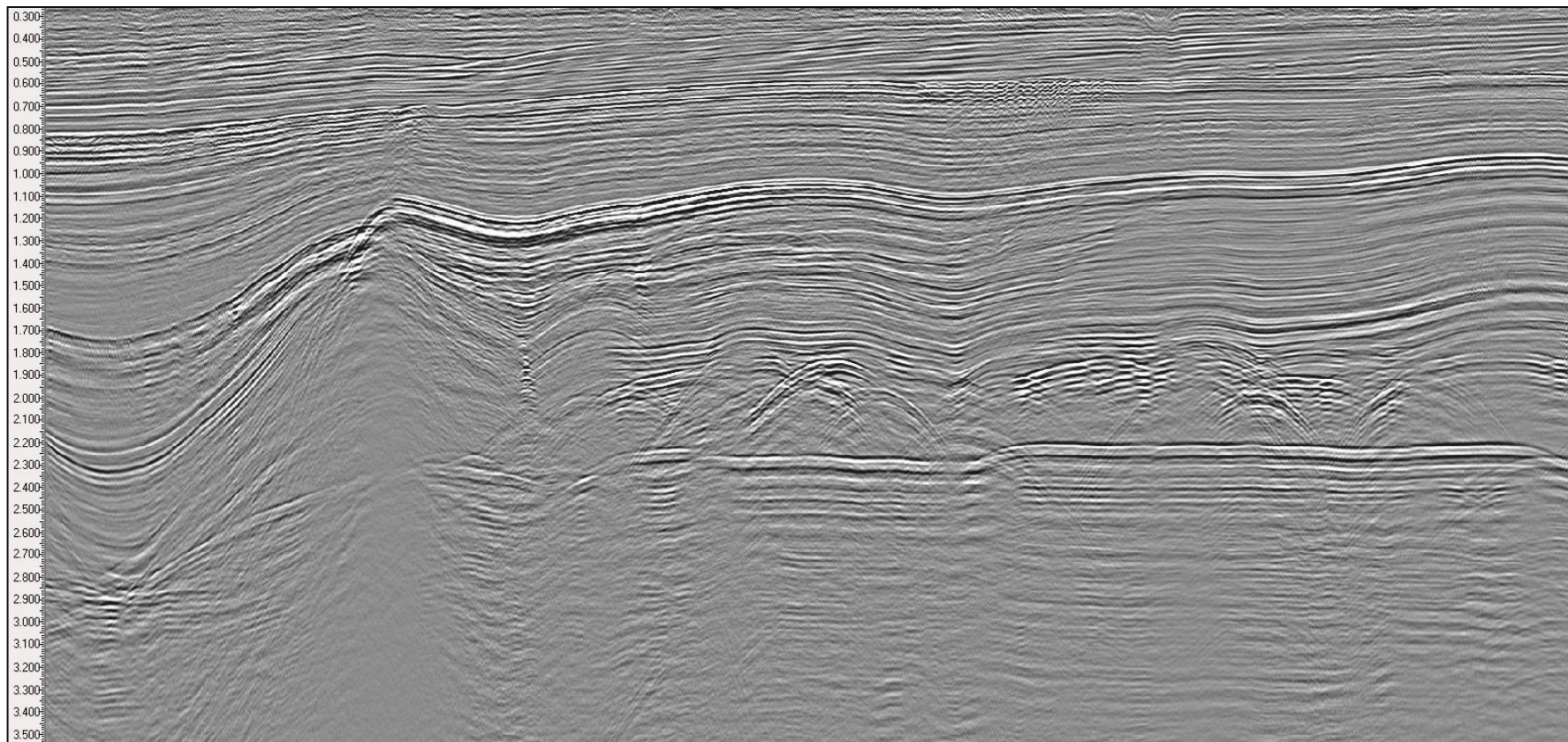
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Brute Stack Time Section

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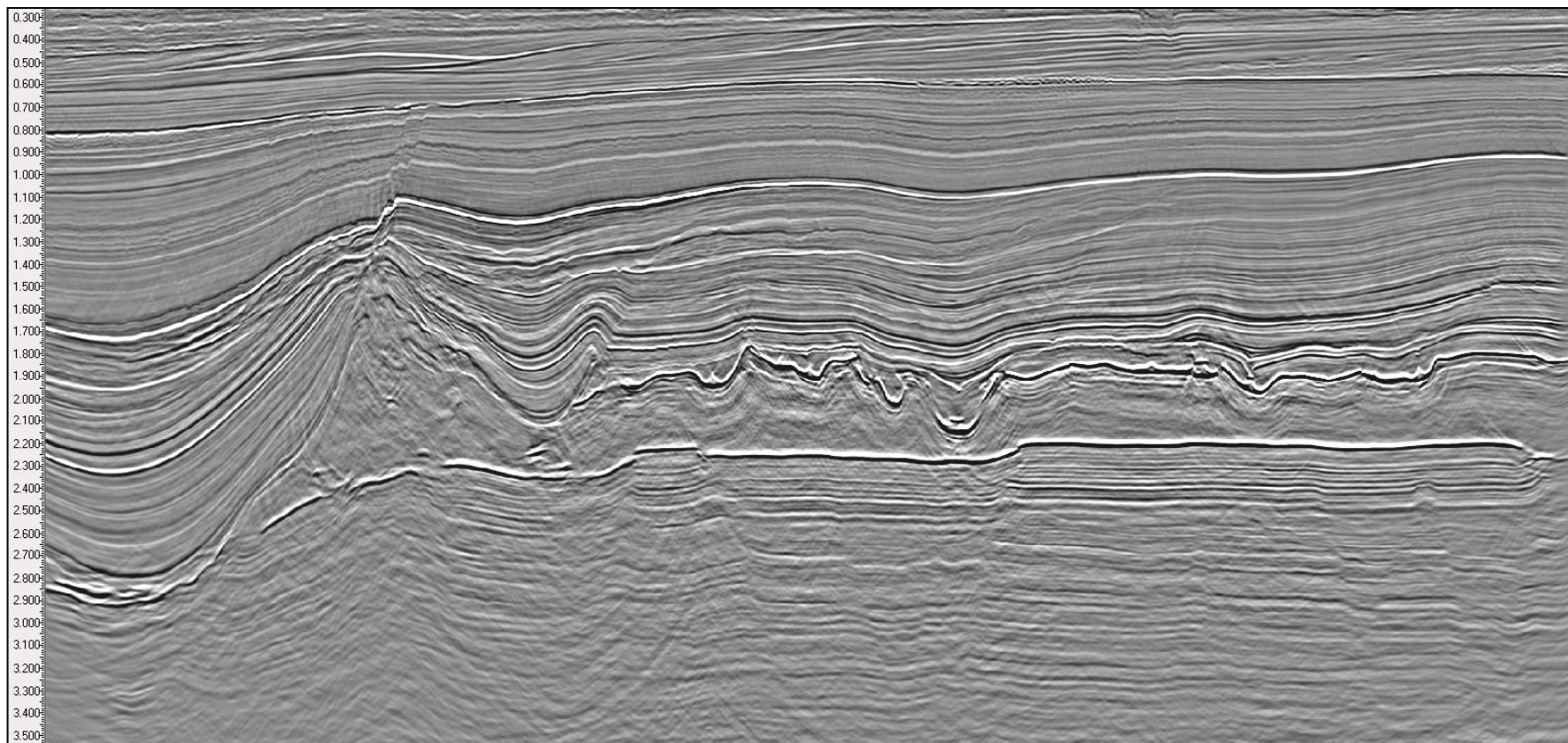
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PSDM Stack Time Section

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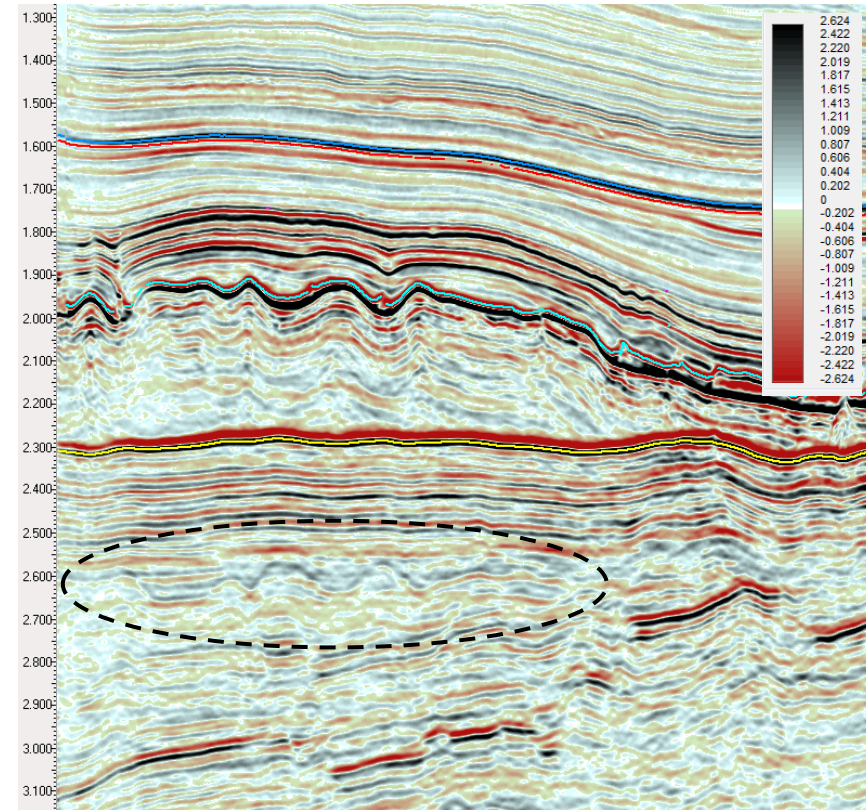
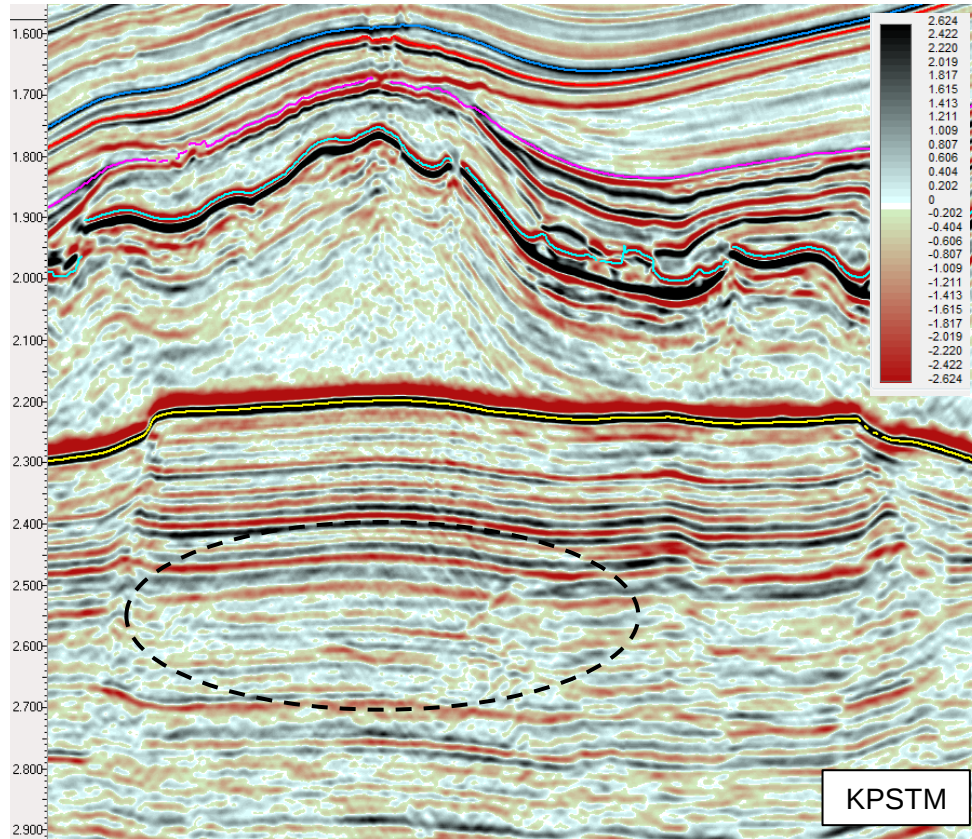
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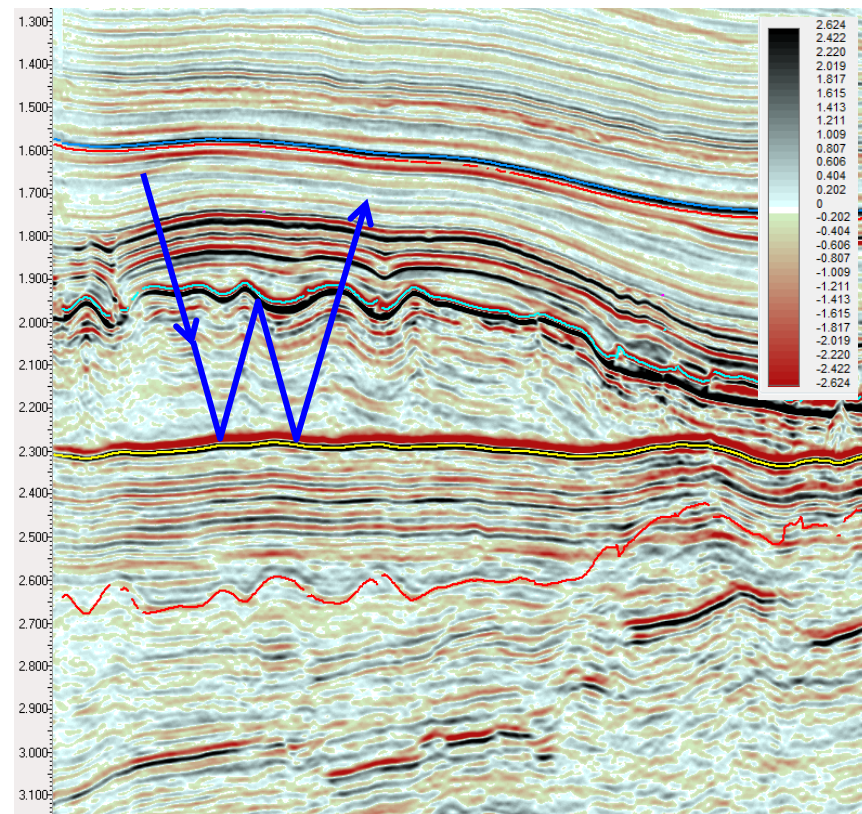
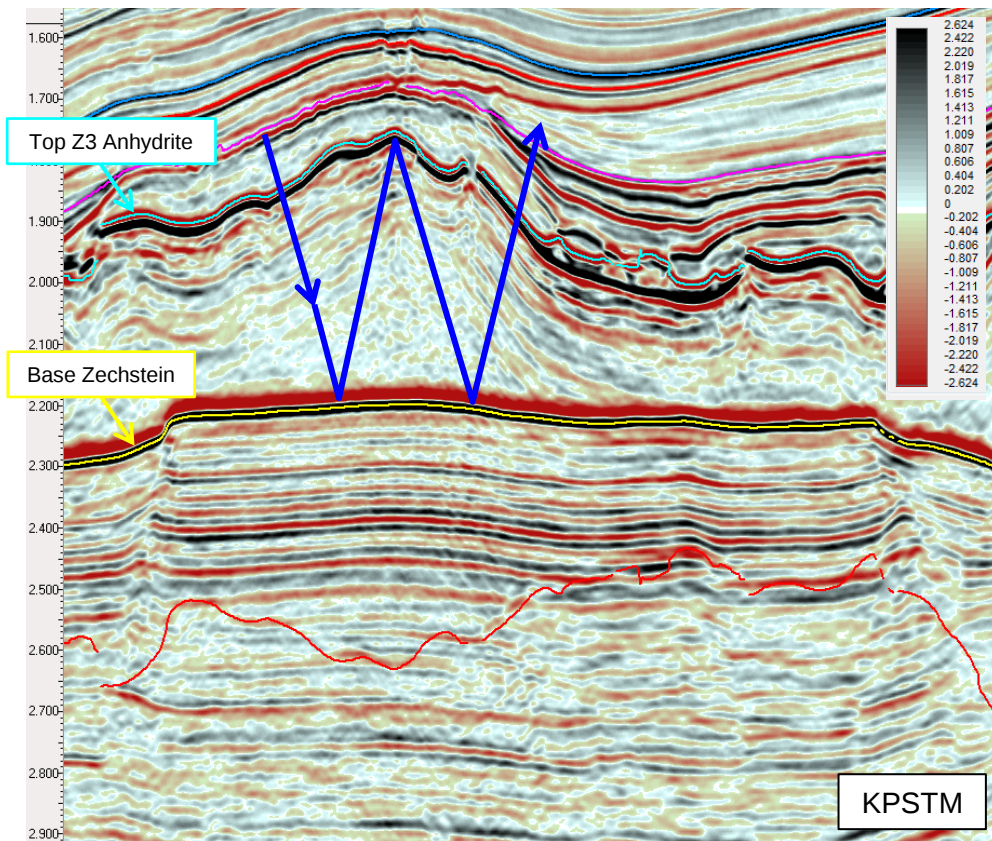
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Inter-bed Multiple

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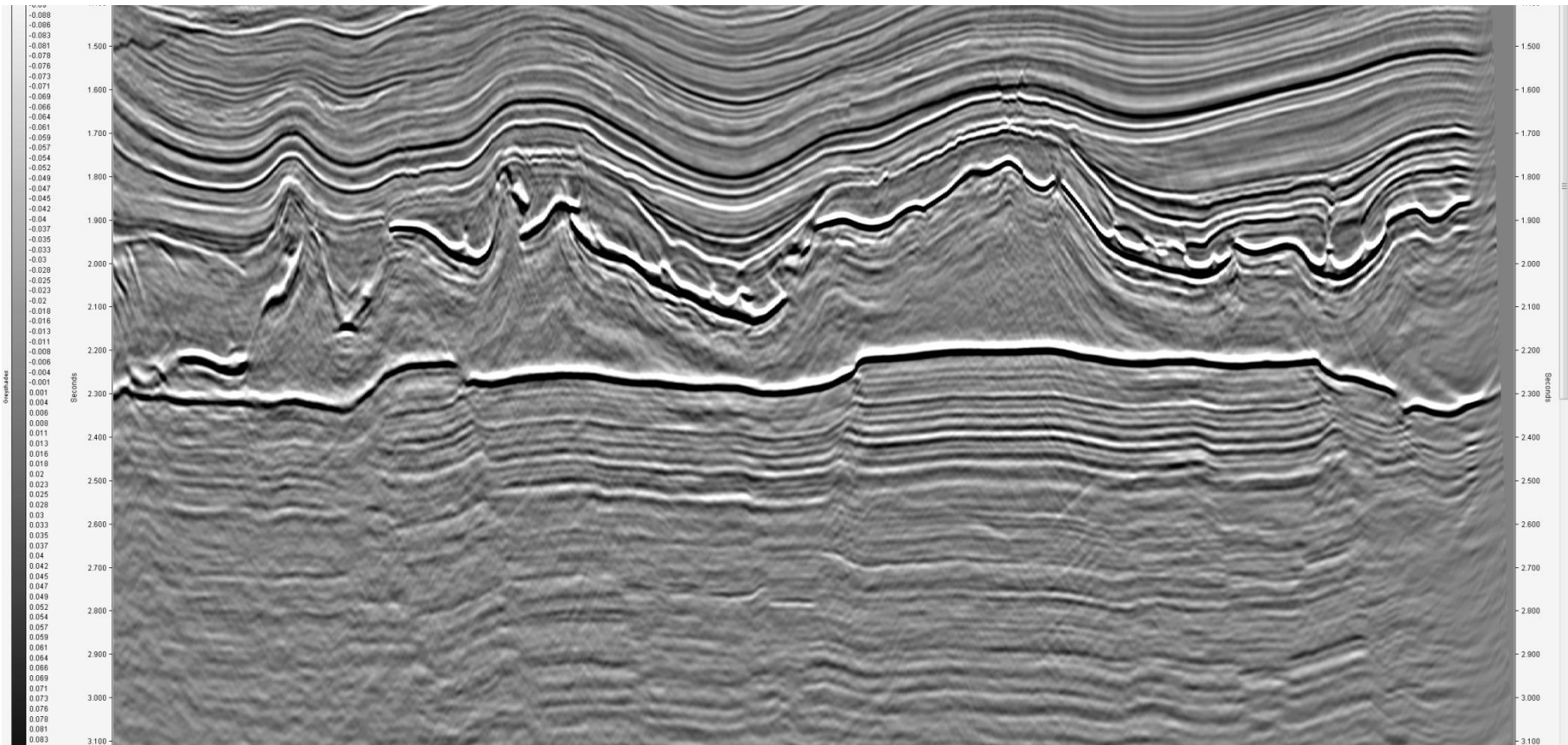
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Inter-bed Multiple Removal - before

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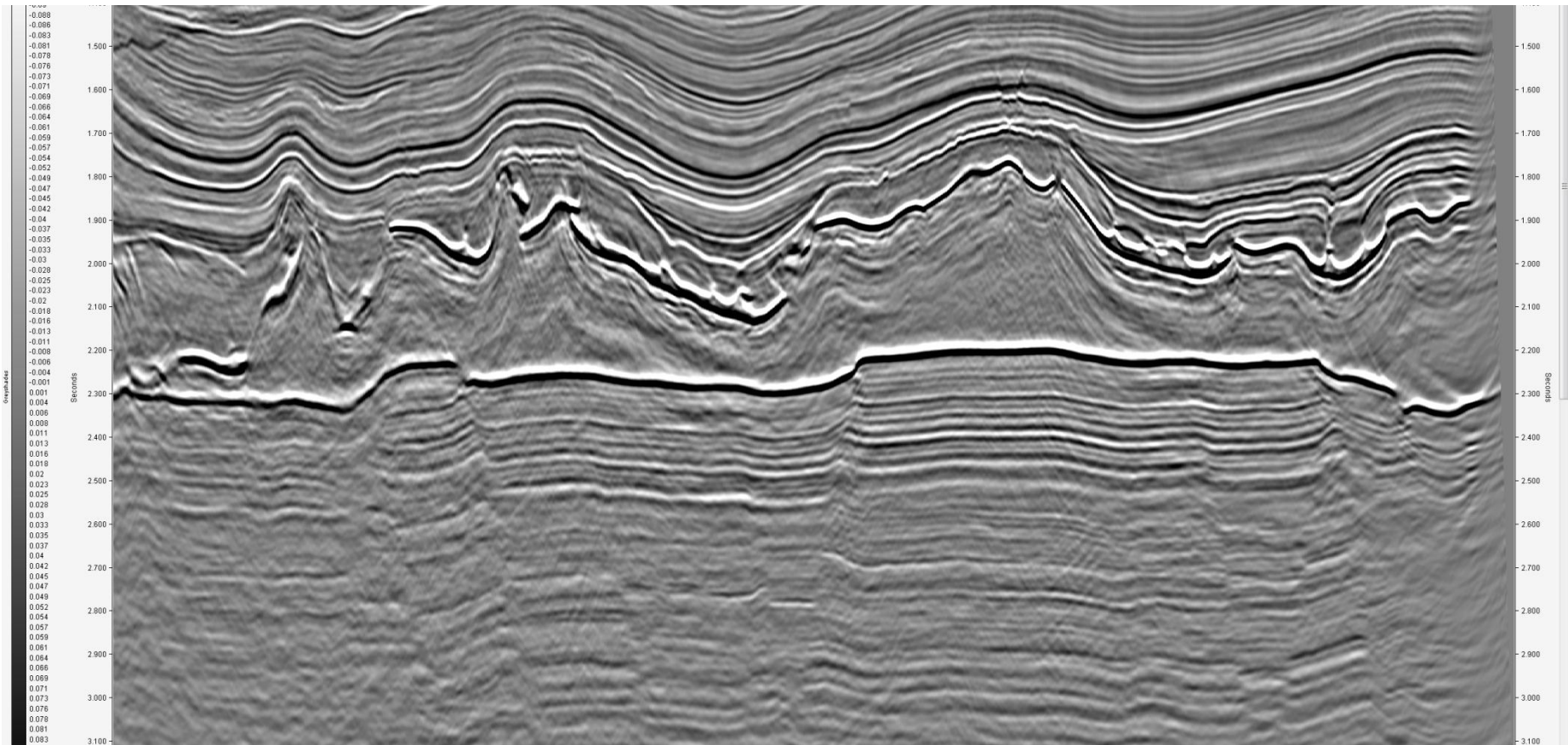
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Inter-bed Multiple Removal - after

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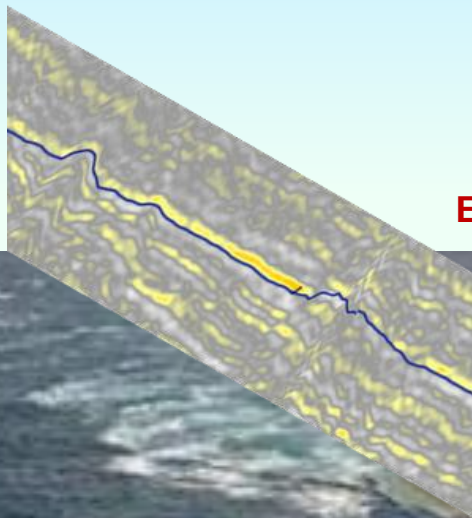
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Summary & Conclusions

- CLA worked well, operationally and technically; we would do it again
- Early dialogue with other stakeholders was invaluable
- We were lucky – a once only opportunity for 3D seismic
- Significant barriers to marine seismic acquisition are already in place, both physical and regulatory
- Regulations are evolving fast and not in our favour.





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Thank you

