

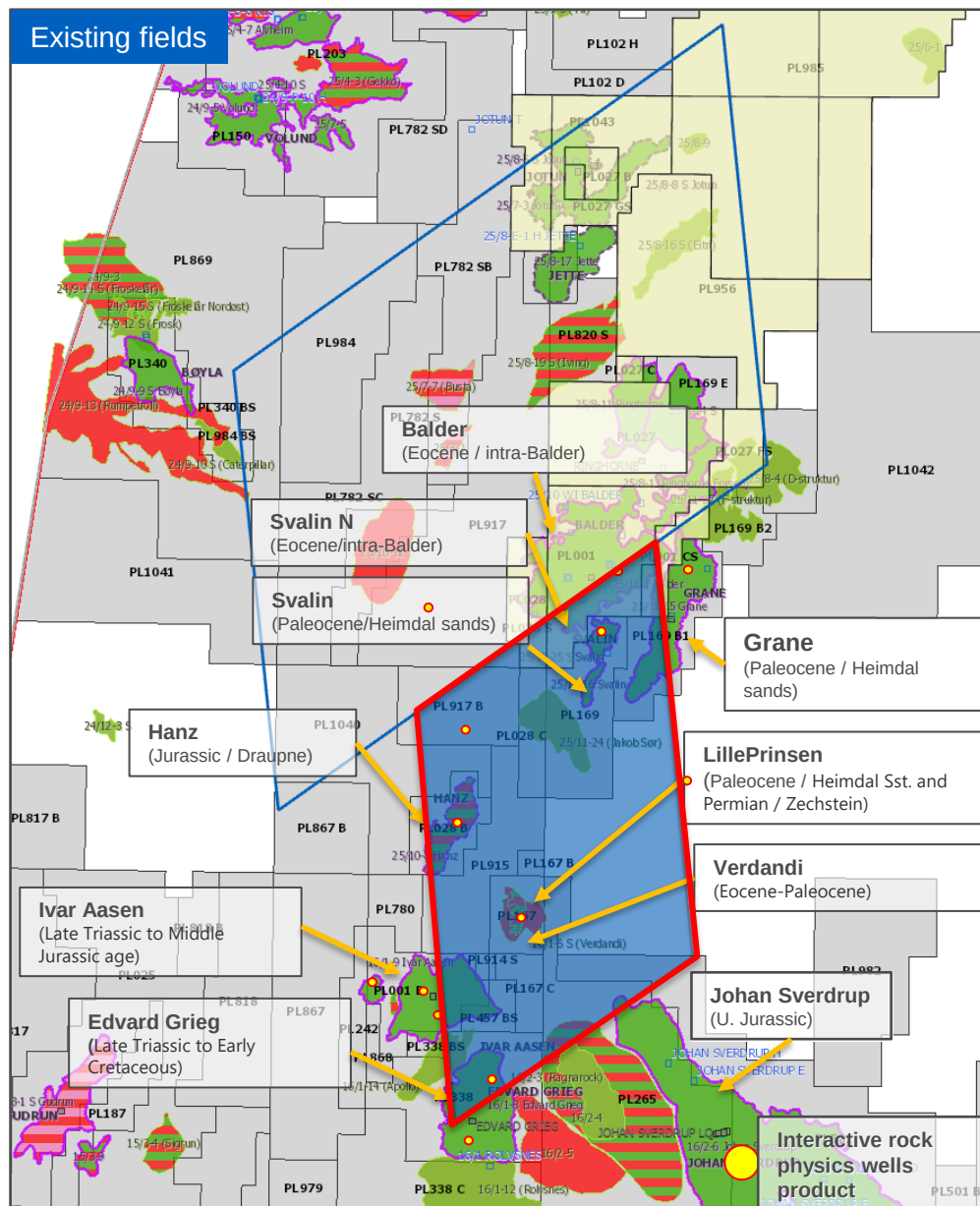


Multisensor, Multi-Azimuth Quantitative Interpretation: A Case Study from the South Viking Graben, Norway

C. Reiser* and E. Mueller, PGS
& with a lot of background work by T. Bird & L. Goswami

Outline

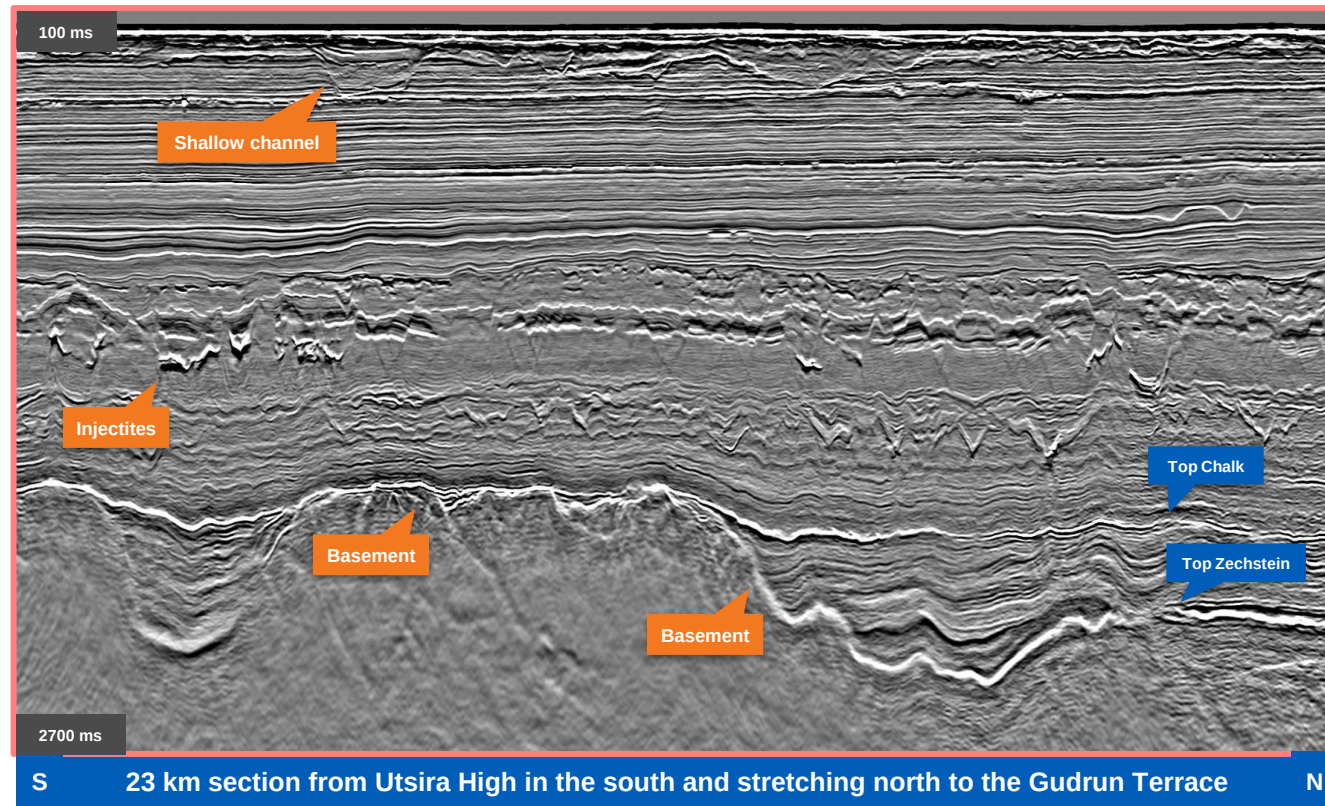
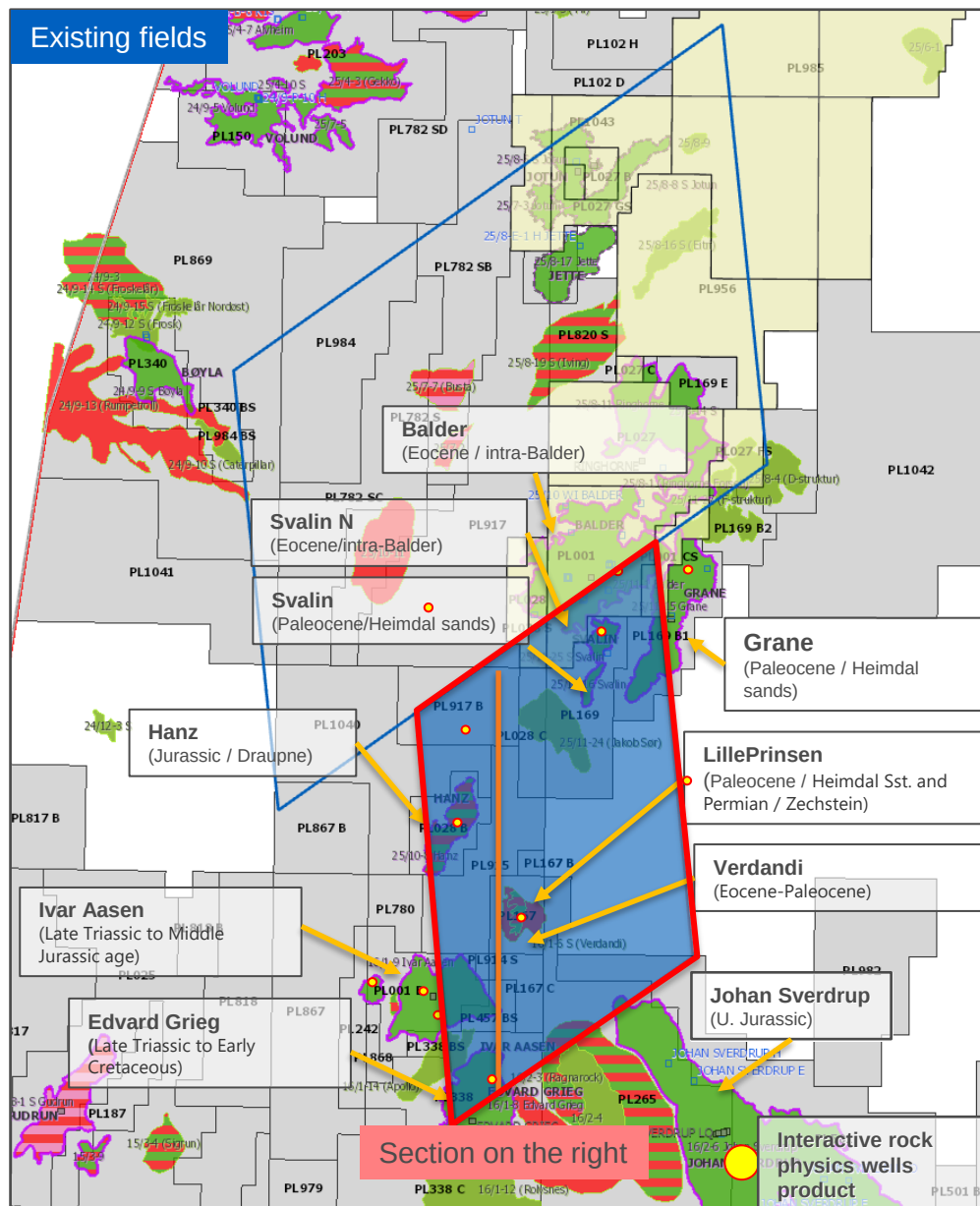
- Introduction
 - Area of Interest
 - The Challenges
 - The Value Proposition
- Results Overview:
 - rockAVO in the area
 - Azimuthal seismic overview and results
 - QI / Brief prospectivity results
- Summary and Conclusions



Major Norwegian fields are located in this area over several stratigraphic intervals:

- **Balder, Grane, Svalin**
 - Eocene – Balder sands
 - Paleocene – Heimdal sands
- **Hanz field**
 - Upper Jurassic – Draupne
- **Johan Sverdrup**
 - Upper Jurassic intra-Draupne sandstone
- **Ivar Aasen**
 - Late Triassic to Mid. Jurassic
- **Edvarg Grieg**
 - Late Triassic to Early Cretaceous sandstone
- **Verdandi** discovery in 2003 and more recent discovery with **Lille Prinsen** in 2018:
 - various hydrocarbon intervals in
 - Eocene (Grid sand), Paleocene (Heimdal sand) and Permian (Zechstein Group).

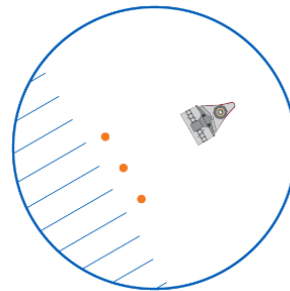
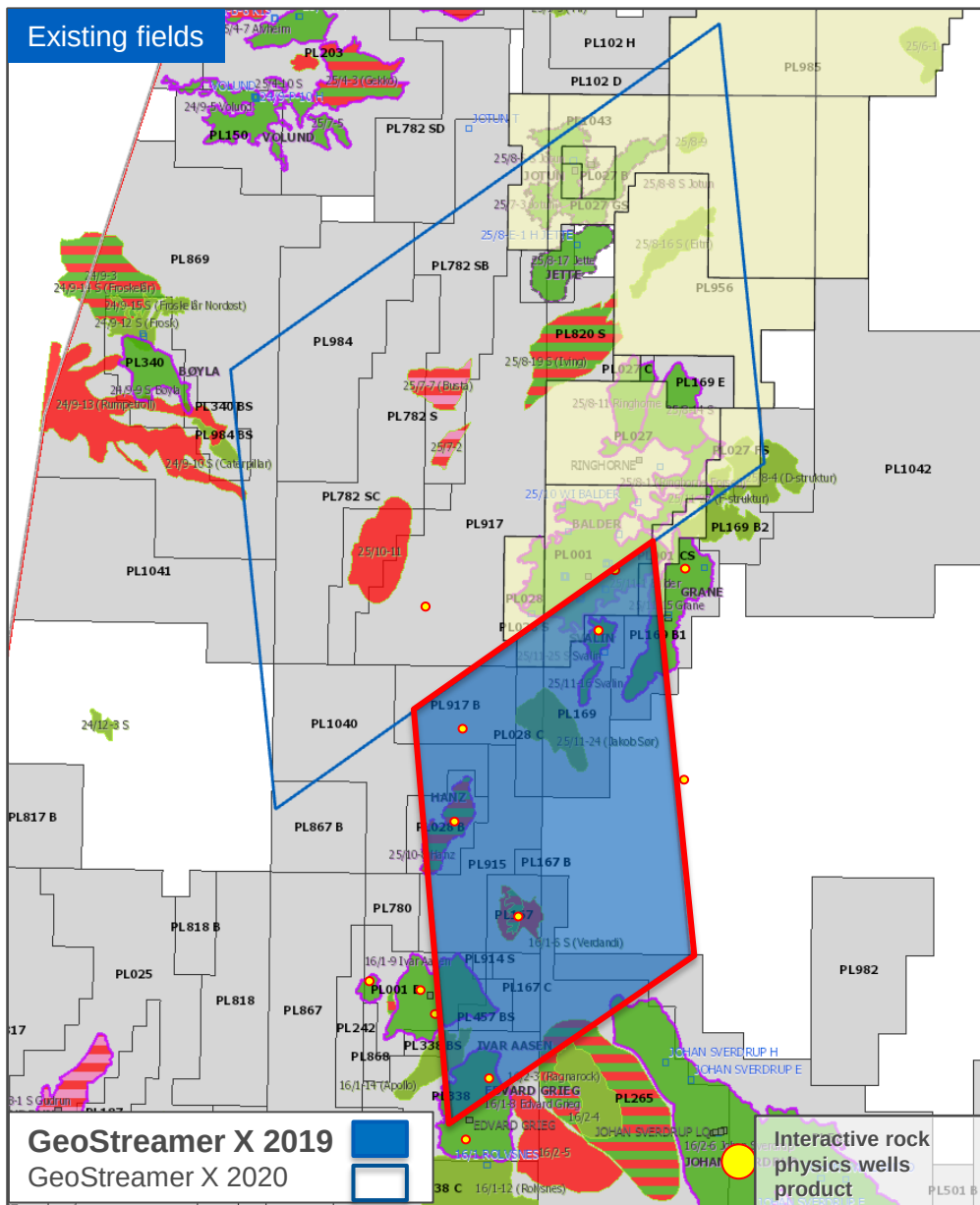
Area of Interest | Viking Graben - The Challenges



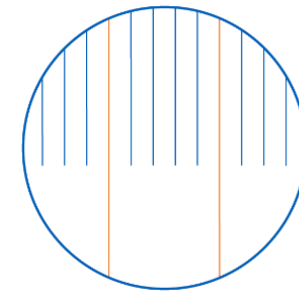
Challenges:

- Shallow subsurface channels, shallow gas,
- Tertiary low velocity anomalies and high velocity sand injectites - V-brights
- Paleogene polygonal faults and
- High impedance rugose Late Cretaceous Chalk

Multi-Azimuth Multisensor Viking Graben | Acquisition Parameters 2019

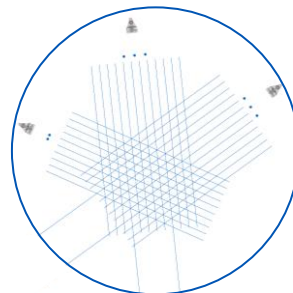


Wide Tow Triple Source
Source separation: 112.5
Total source separation: 225m



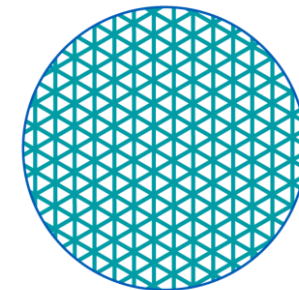
12 Streamer Spread with Tails

10 Streamers: 6 000m
2 Streamers: 10 000m



Multi-Azimuth

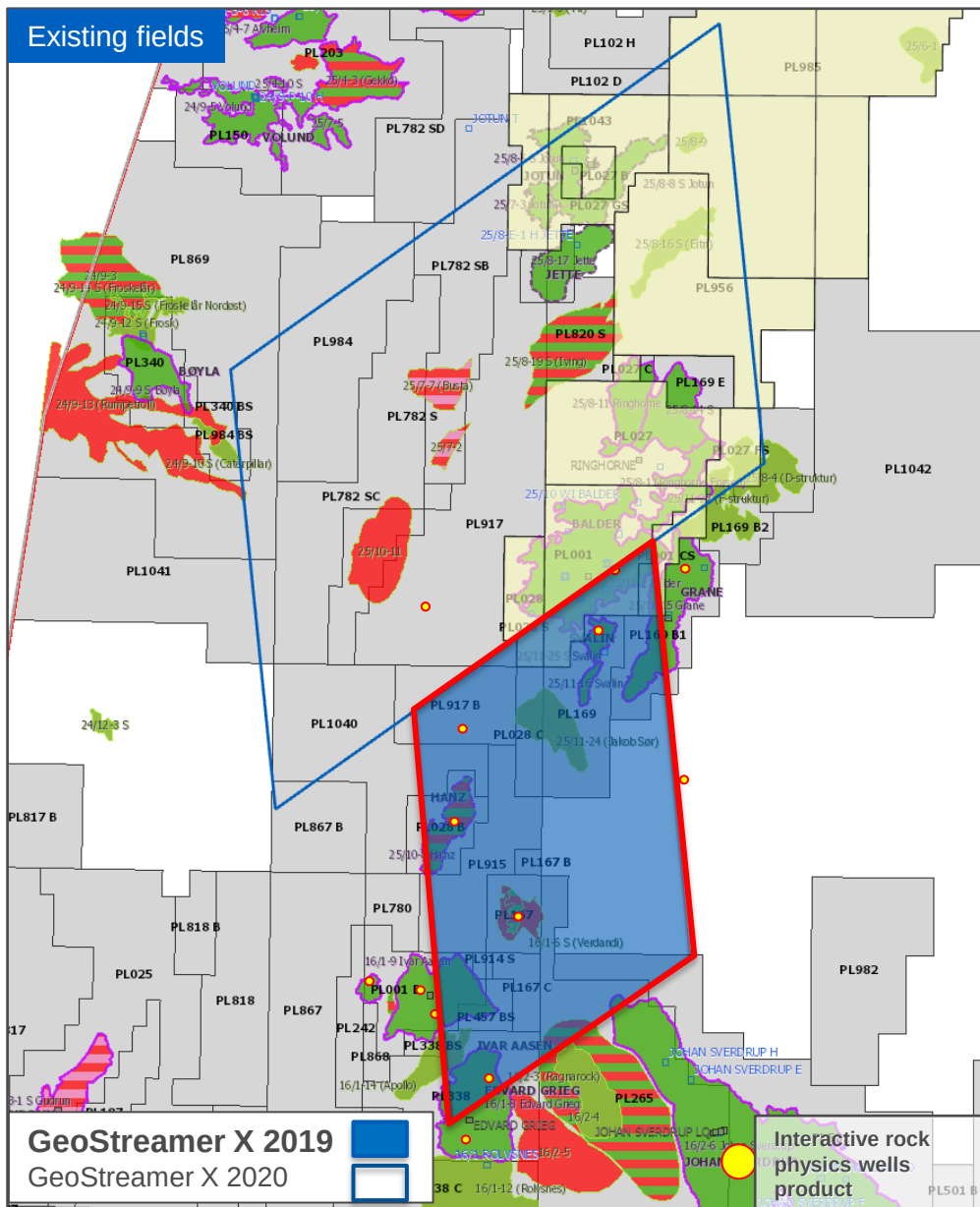
- 1 legacy GeoStreamer
- 2 additional GeoStreamer (2019)



Dense Spread
Streamer separation: 85m

Widmaier, M., O'Dowd, D., Roalkvam, C., Ciotoli, M. and Limonta, L. [2020]
Addressing imaging challenges in the Viking Graben with multi-azimuth acquisition, longer offsets, and wide-tow sources. SEG International Exposition and 90th Annual Meeting

Multi-Azimuth Multisensor Viking Graben | Brief Imaging Sequence Review



Sail line processing, line-by-line

Denoise, wavefield separation, deghosting/designature

Comprehensive 3D demultiple (SWIM & SRME)

Full Waveform Inversion using:

refraction up to 12Hz (0-10 km) +
reflection up to 15Hz (0-6 km)

4D/5D data regularization

All surveys/azimuths
Offset/azimuth binning and regularization

Kirchhoff PSDM

Offset/azimuth CDP gathers

Optimized azimuthal correction & weighted stack

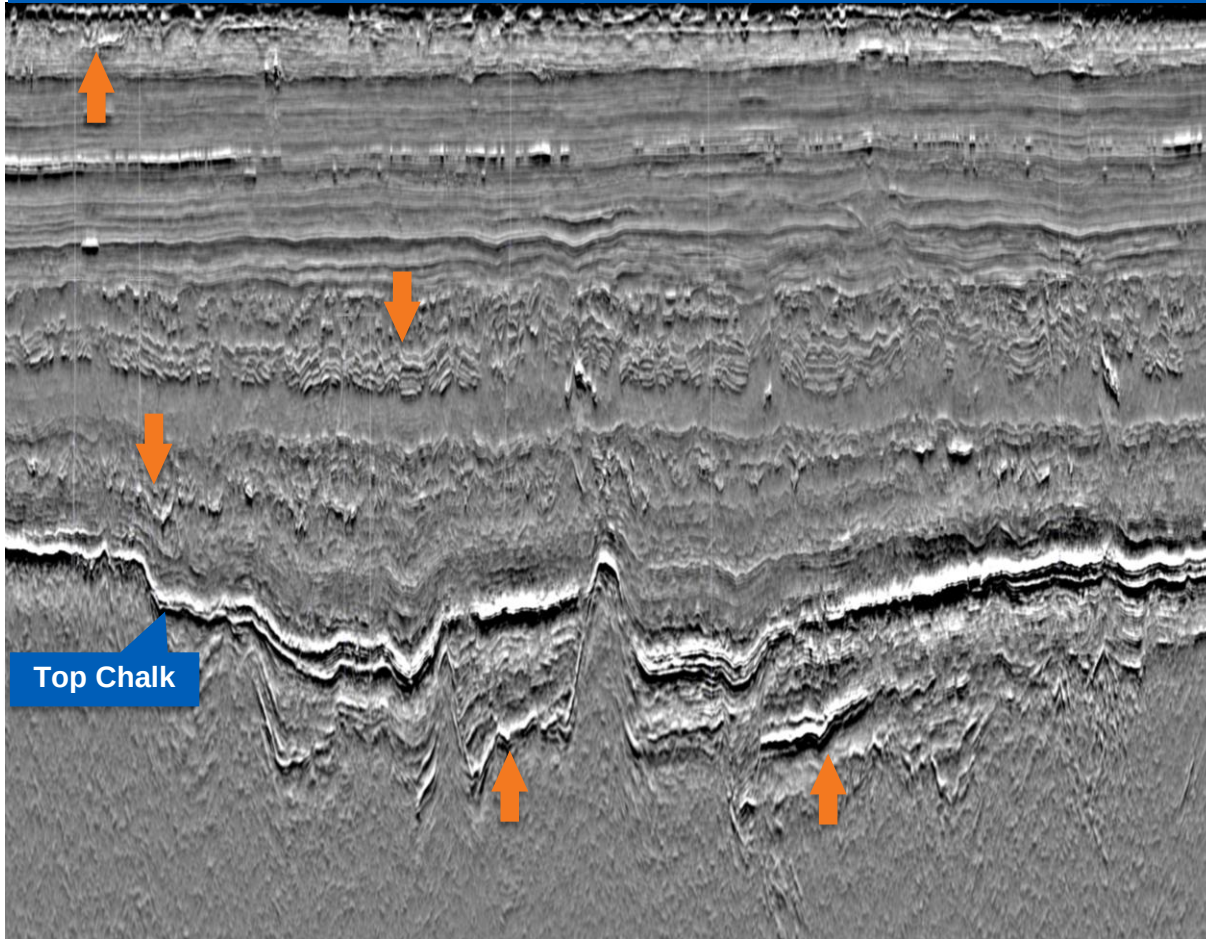
RMO/gather flatness, denoise, MAZ stack, Az. stack

Oukili J, Limonta L, Budner M, Mueller E, Kultom-Karlsen T. [2020]

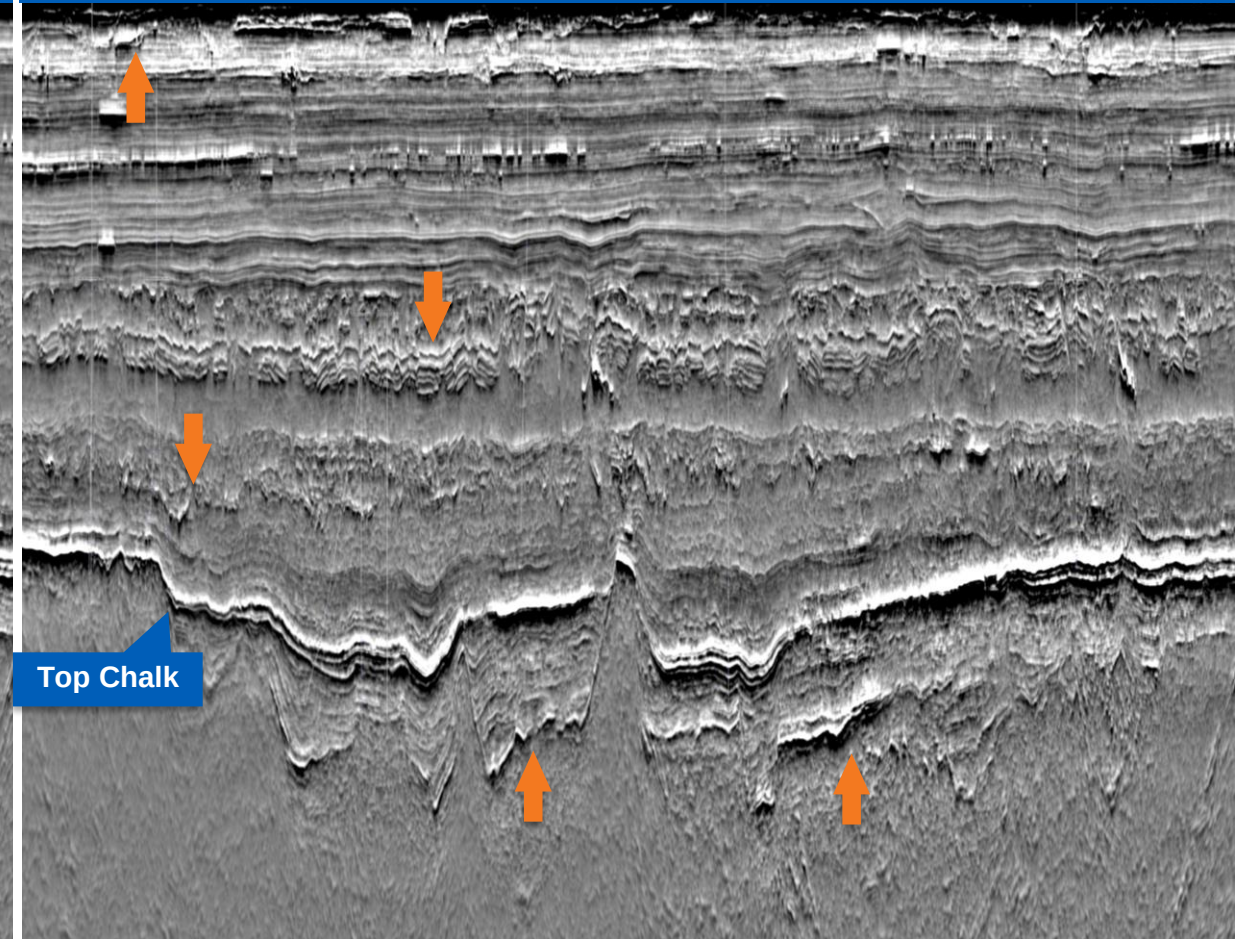
Revealing new opportunities with a cost-effective towed streamer MAZ solution in the South Viking Graben, Norway, First Break, 38, 95-101, DOI: 10.3997/1365-2397.fb2020085

Legacy | Multi-Azimuth Multisensor Regional Section (Relief section)

Legacy

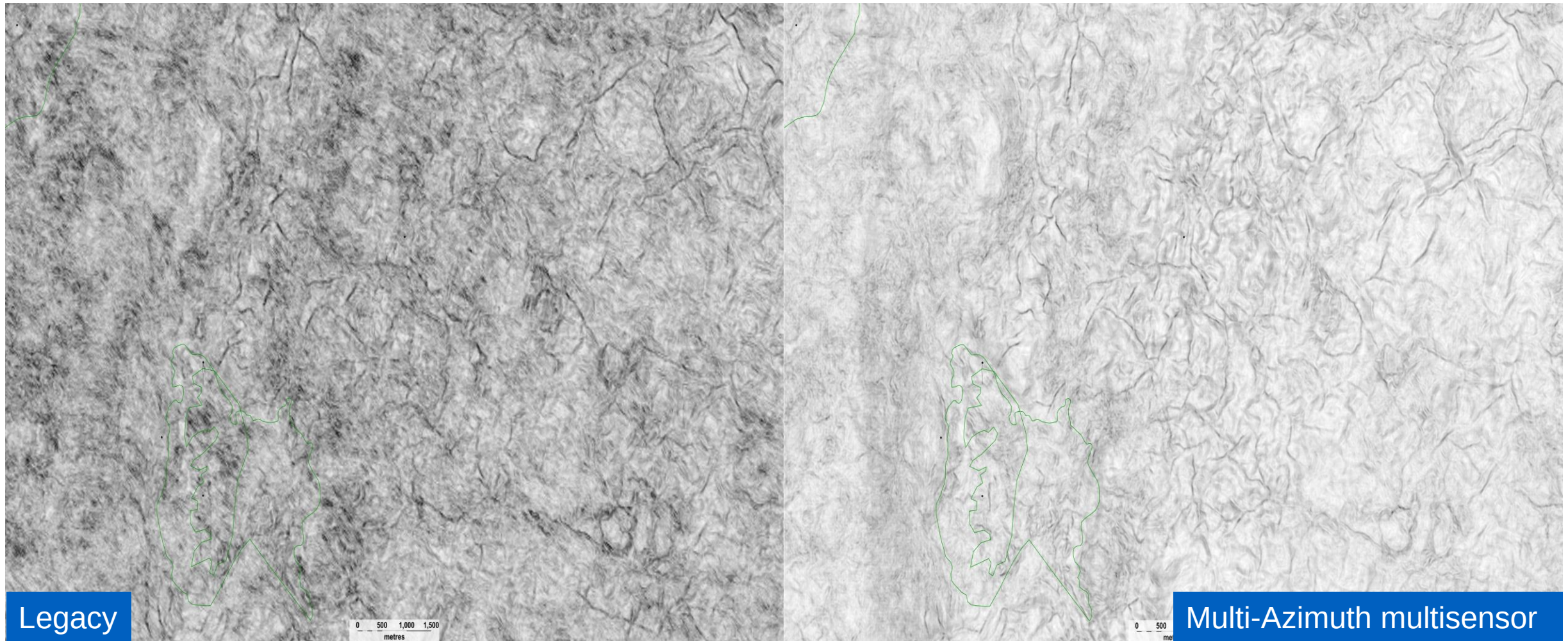


Multi-Azimuth Multisensor 2019



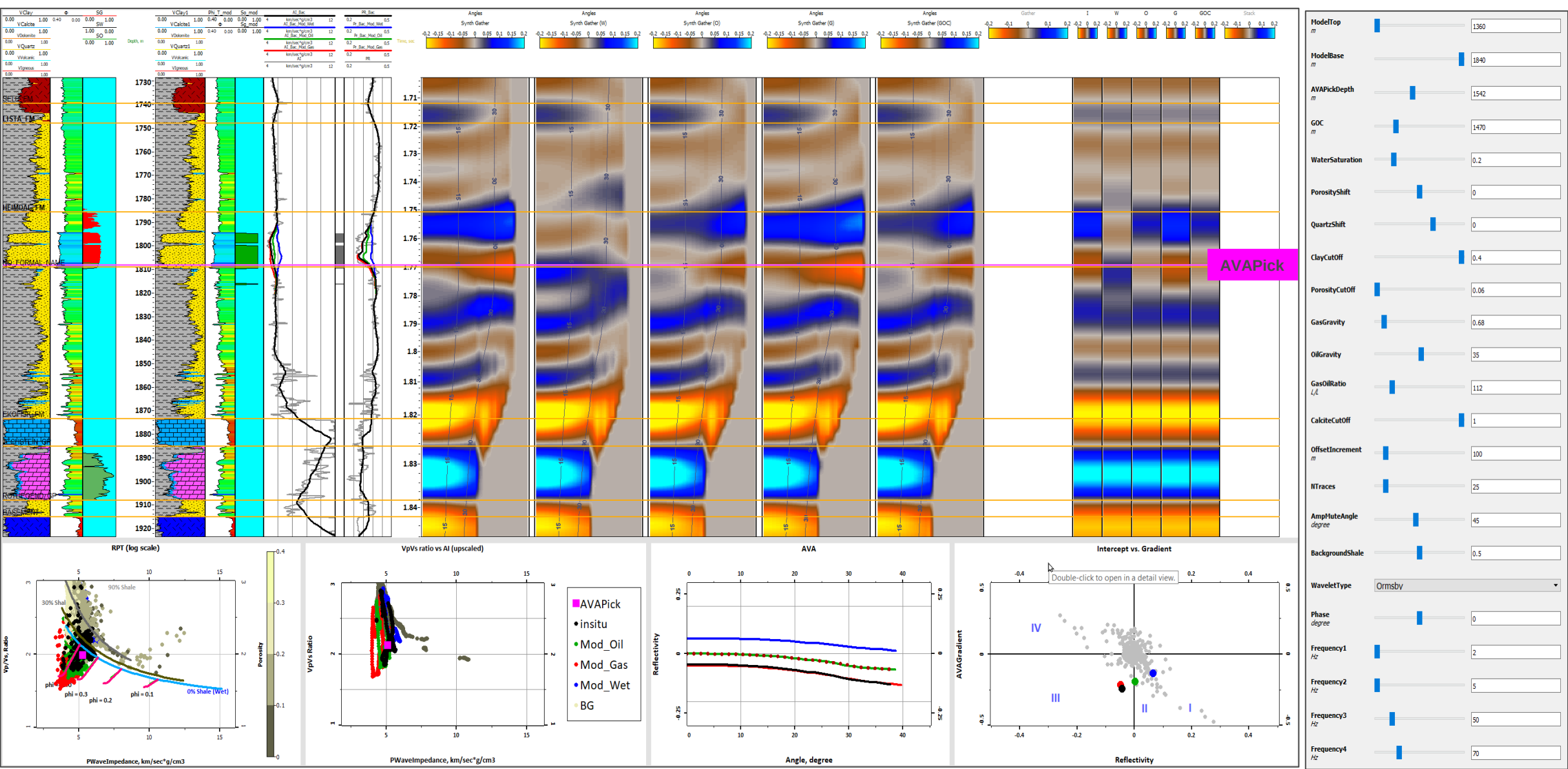
Better reflector continuity (sharper – cleaner) and improved signal to noise ratio

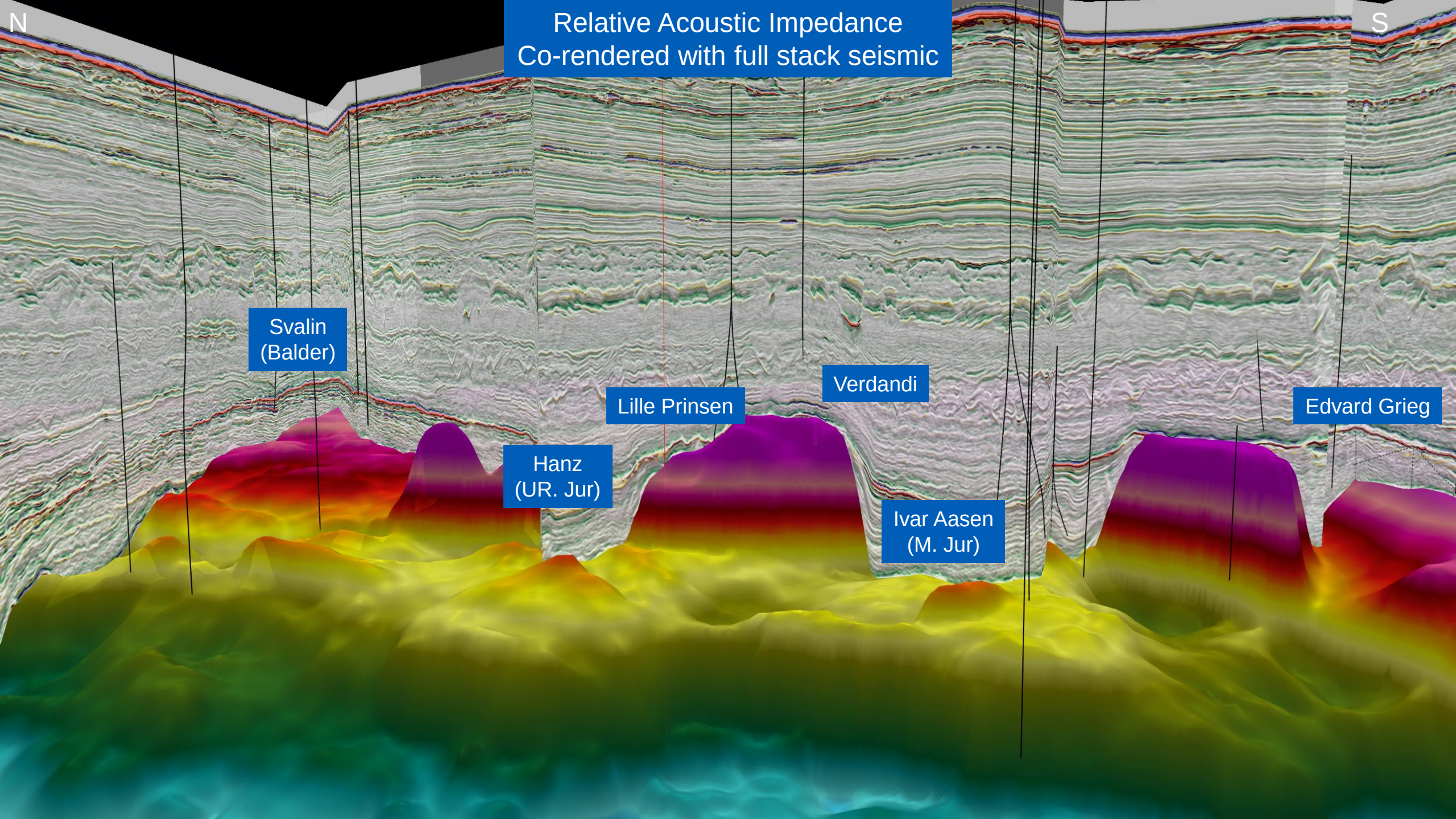
Top Balder - Fault Detection & Resolution Improvement



Top Balder Incoherency map showing polygonal faulting in the Lille Prinsen field vicinity
Enhanced discontinuity contrast and visibility with the Multi-Azimuth multisensor dataset

rockAVO - 16/1-29ST2 (Lille Prinsen) – Clastic Section





Relative Acoustic Impedance
Co-rendered with full stack seismic

Svalin
(Balder)

Lille Prinsen

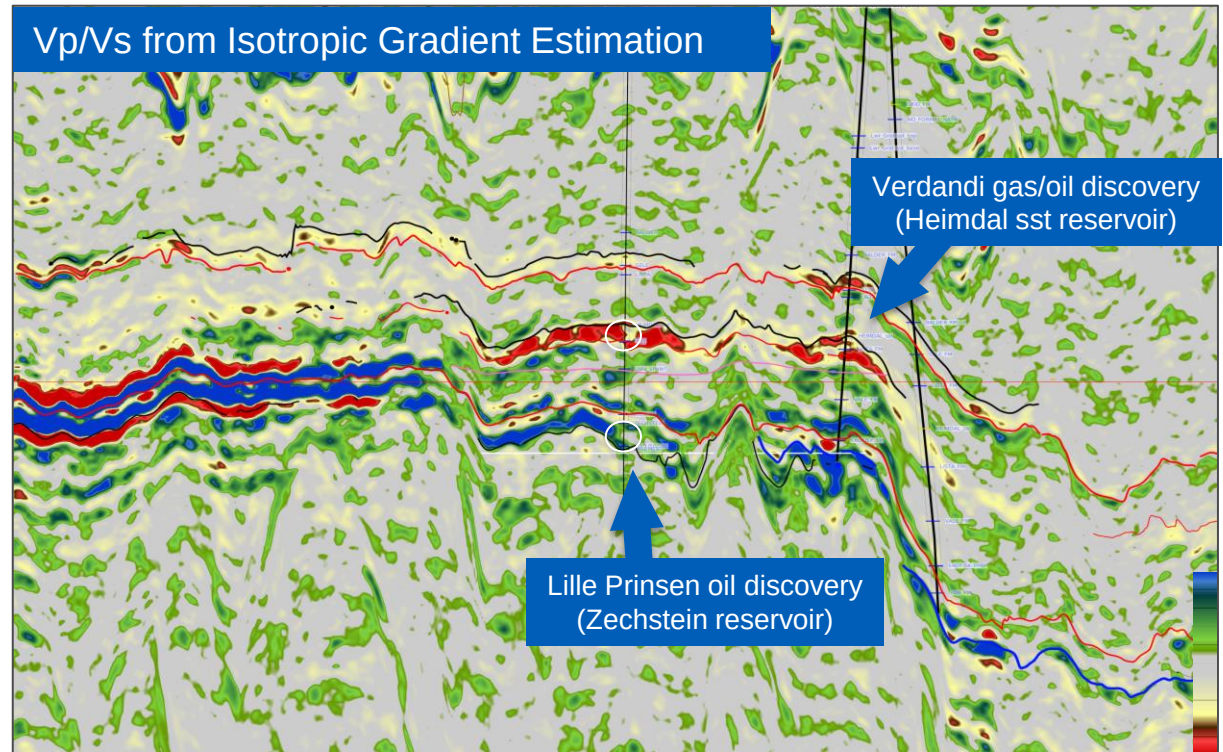
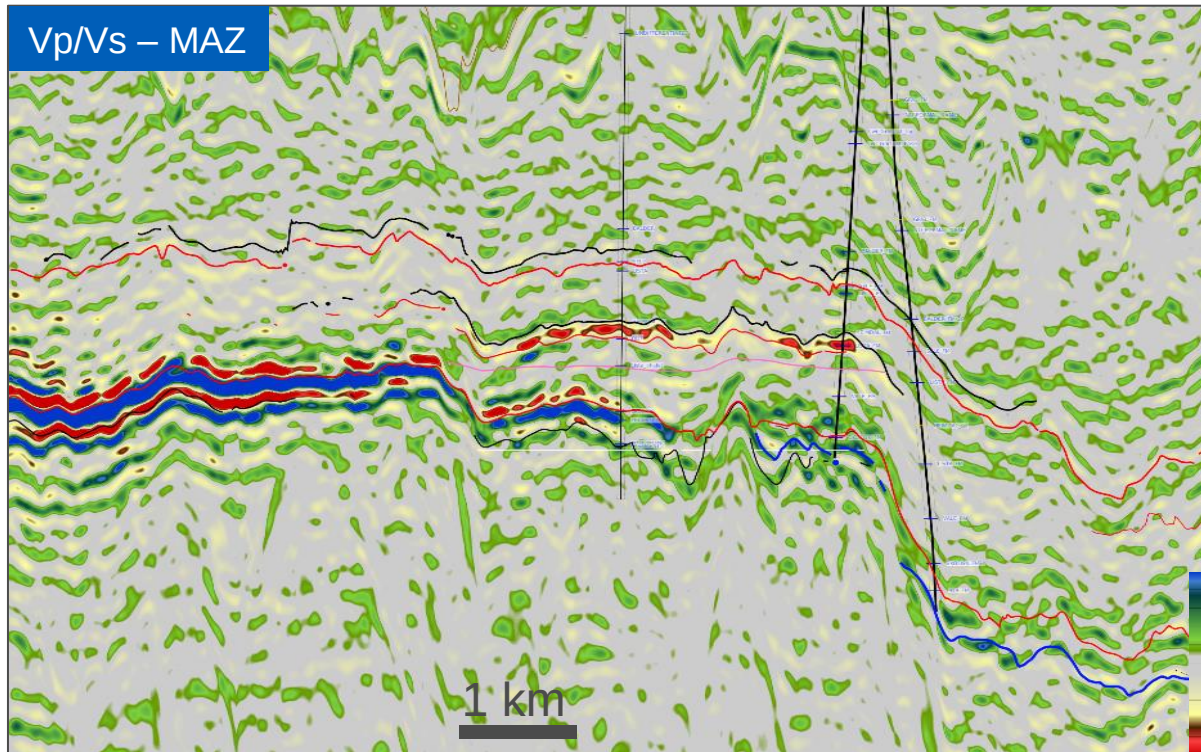
Verdandi

Edvard Grieg

Hanz
(UR. Jur)

Ivar Aasen
(M. Jur)

Elastic Attributes MAZ vs. Azimuthal

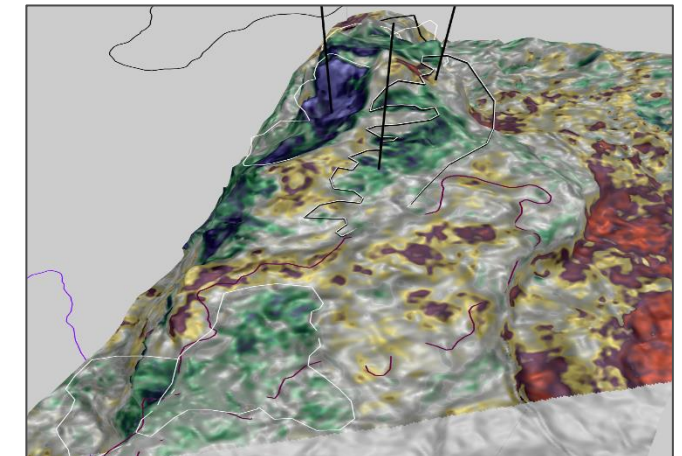
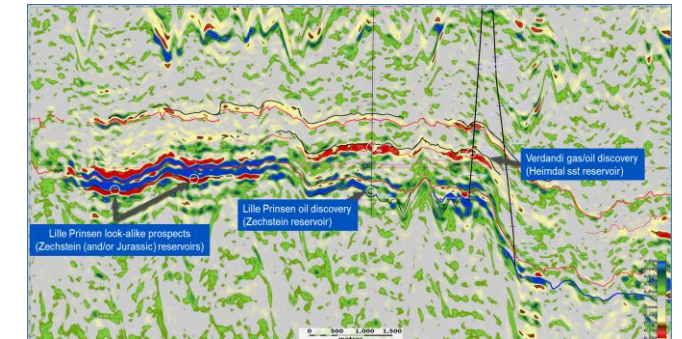
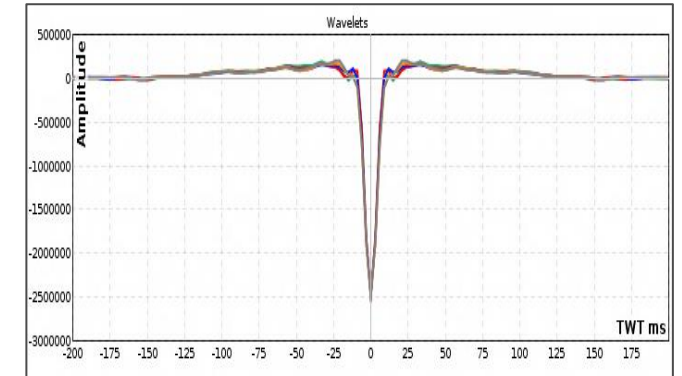


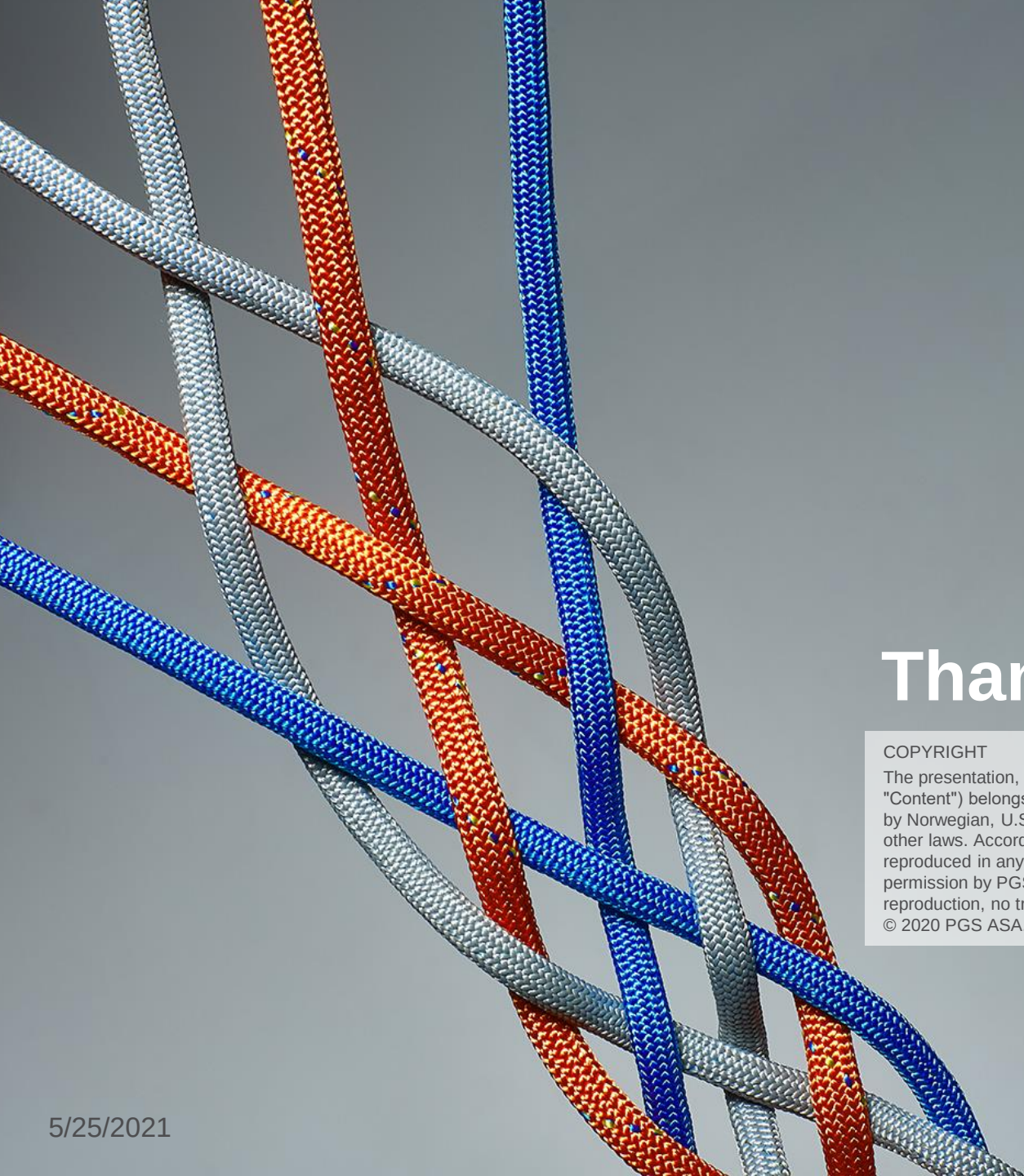
Significant Improvement between the NAZ legacy data to the Azimuthal Acquisition.

- Improved SNR
- Higher Resolution
- Accurate Fluid Identification and prediction
- Improved Leads – Prospects Identification and Derisking

Summary

- **Innovative acquisition** set-up with wide-towed sources (3) MAZ multisensor dataset has:
 - Overcome some complex geological & geophysical challenges
 - Lead to:
 - Very broadband wavelet beneficial for the inversion
 - Very good match at the wells
 - Multi-Azimuth Anisotropy analysis for extraction of Isotropic Gradient and subsequent Isotropic Vp/Vs (work on-going)
- **Mapping of existing fields** at numerous stratigraphic interval (Paleocene, UR Jur. & Permian)
- **Highlighting some clear leads and opportunities**





Thank you

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