Multiazimuth streamers and sparse OBN on Berling

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Sokkeldirektoratets teknologidag

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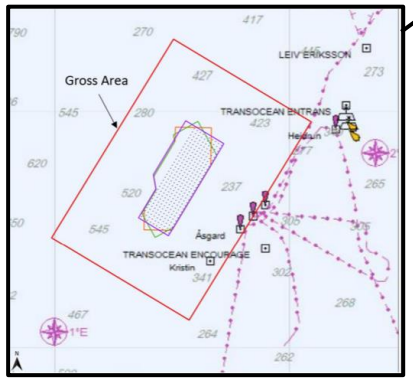
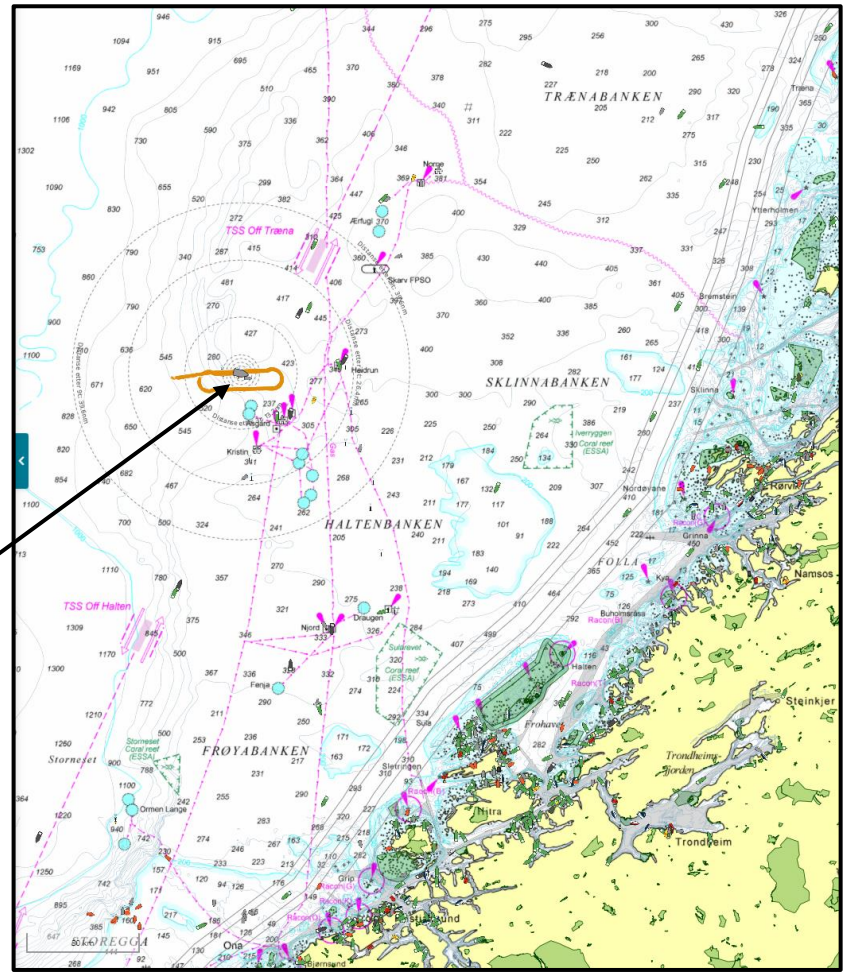
Innovative Streamer & OBN survey acquired Summer 2023

- Three towed streamer surveys in three different azimuths
  - 10 streamers @ 7km
  - 2 streamers @ 10km
  - Slanted streamers
  - Shooting during line changes
- 300 ocean bottom nodes (OBN)

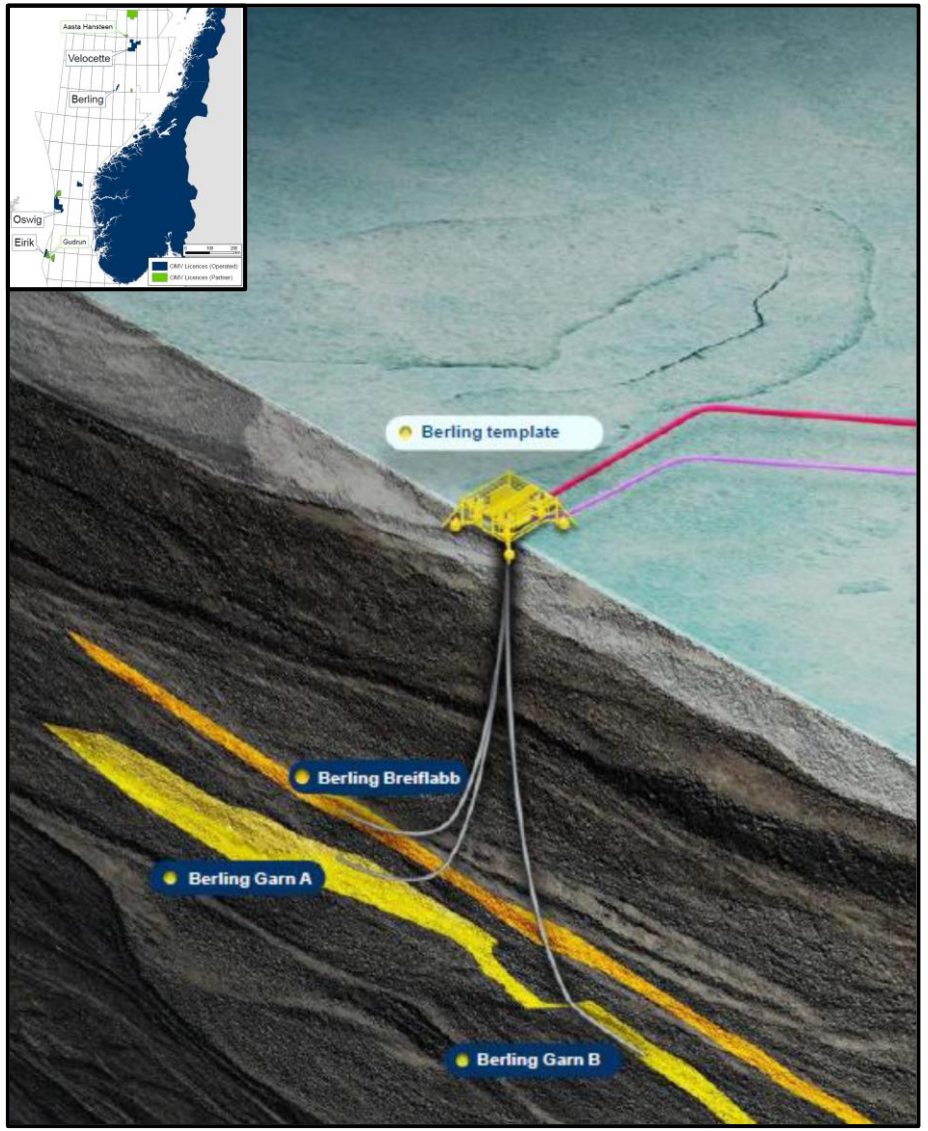




Berling – Multiazimuth streamers and sparse OBN

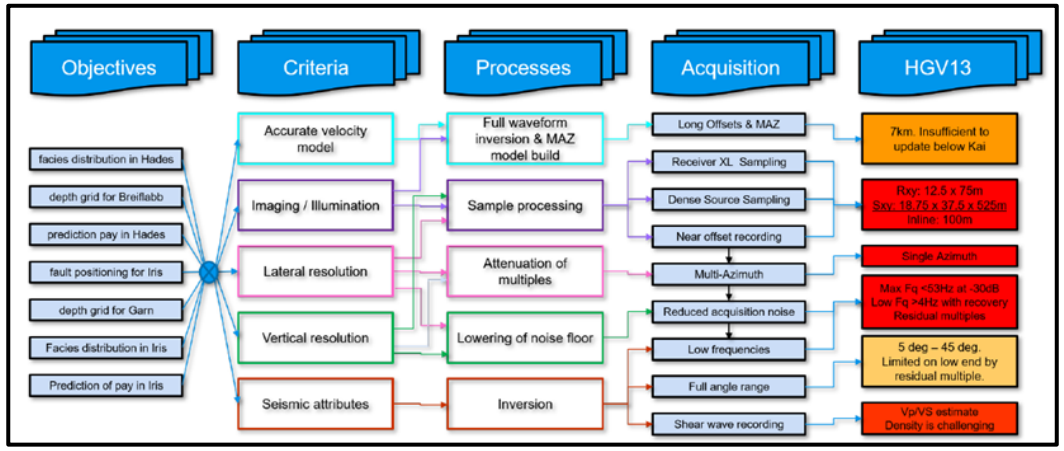
Post PDO activities in challenging subsurface and vulnerable marine areas

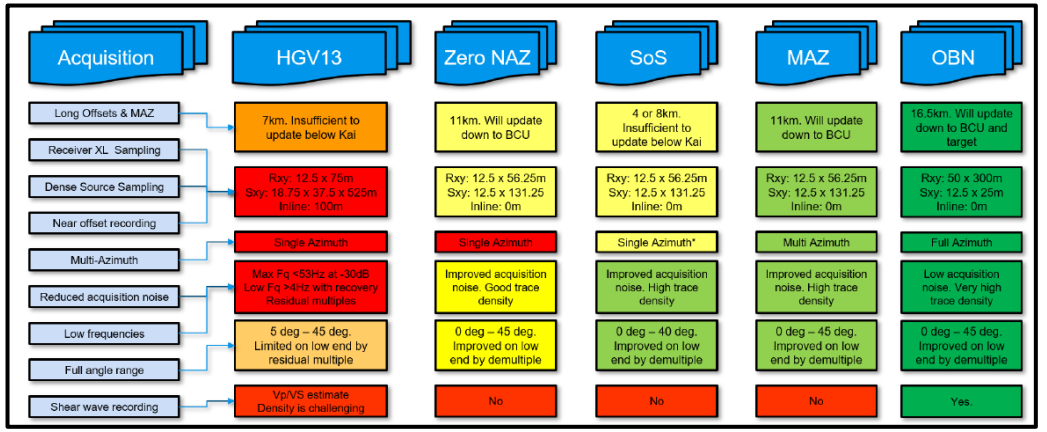
- Berling Garn and Breiflabb discoveries:
  - Deep, complex and thin drilling targets
- Seabed depth 250-480 m and cold water corals
- PDO was awarded Q2 2023
- Will start drilling campaign in Q4 2026
  - Three horizonal development wells
- Ambition to further mature upsides



Enhancing reservoir mapping with new seismic on Berling

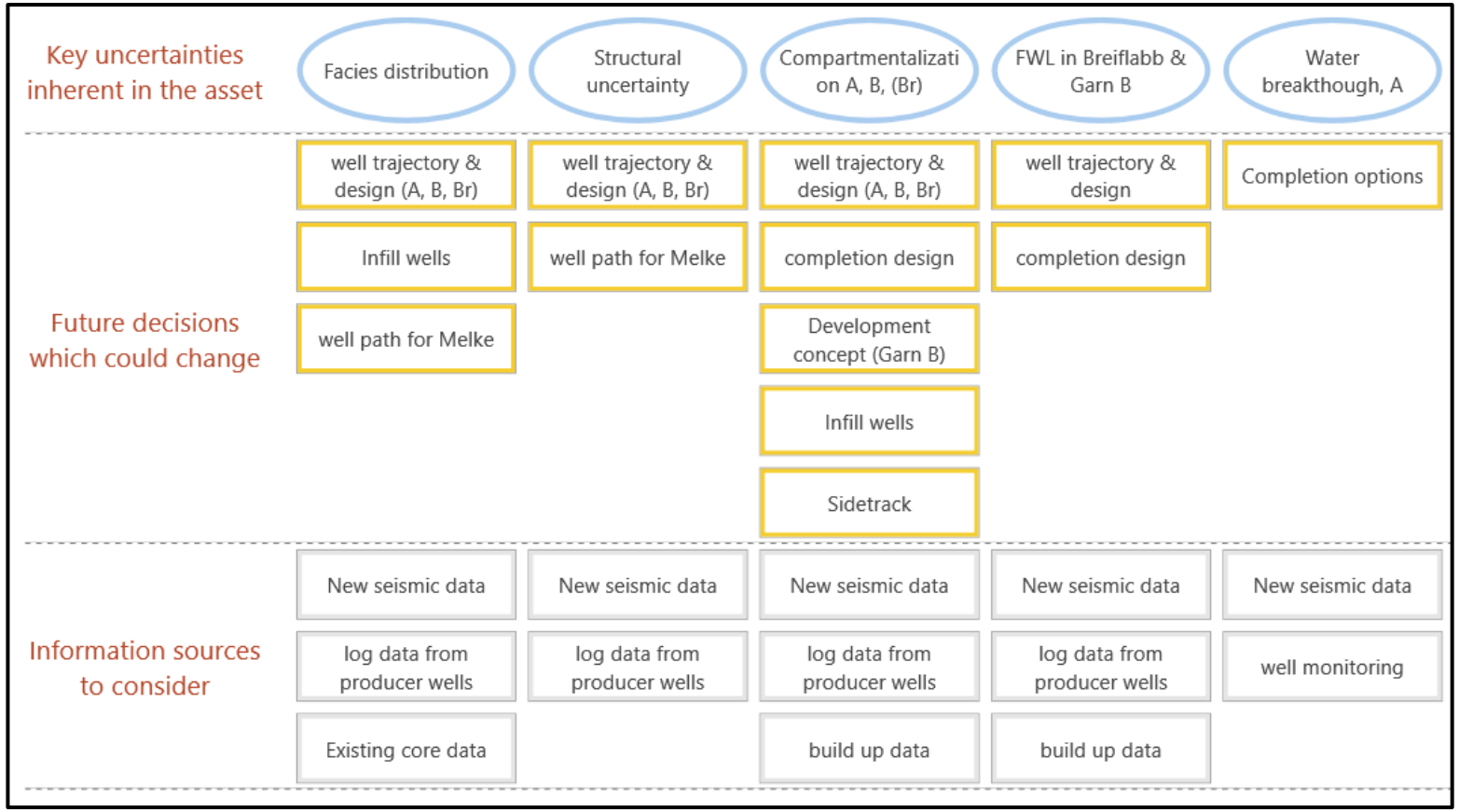
- Why wasn't the legacy seismic good enough?
  - Seismic quality not fit for purpose for future development needs:
    - ➡ *Chasing 10m resolution @ target*
    - ➡ *Accurate and detailed fault imaging*
    - ➡ *Accurate reservoir facies distribution*
    - ➡ *Accurate velocity depth model*
- Which alternatives would work?
  - Systematic analysis of a range of different streamer survey designs and dense OBN
- Is the technical winner worth it???





Several values were identified through the acquisition of new seismic data

- More optimized well trajectories, which has the potential to add incremental resources
- Updated risk and resource estimation of near field targets
- Improved risk reduction during drilling



Analyse phase - Summary

Why we need good data:

- Challenging subsurface
- Drilling complex, horizontal wells
- Further mature upsides

Why wasn't the legacy seismic good enough:

- Limited data quality and poor reliability, resulting in greater uncertainties

Which alternatives would work:

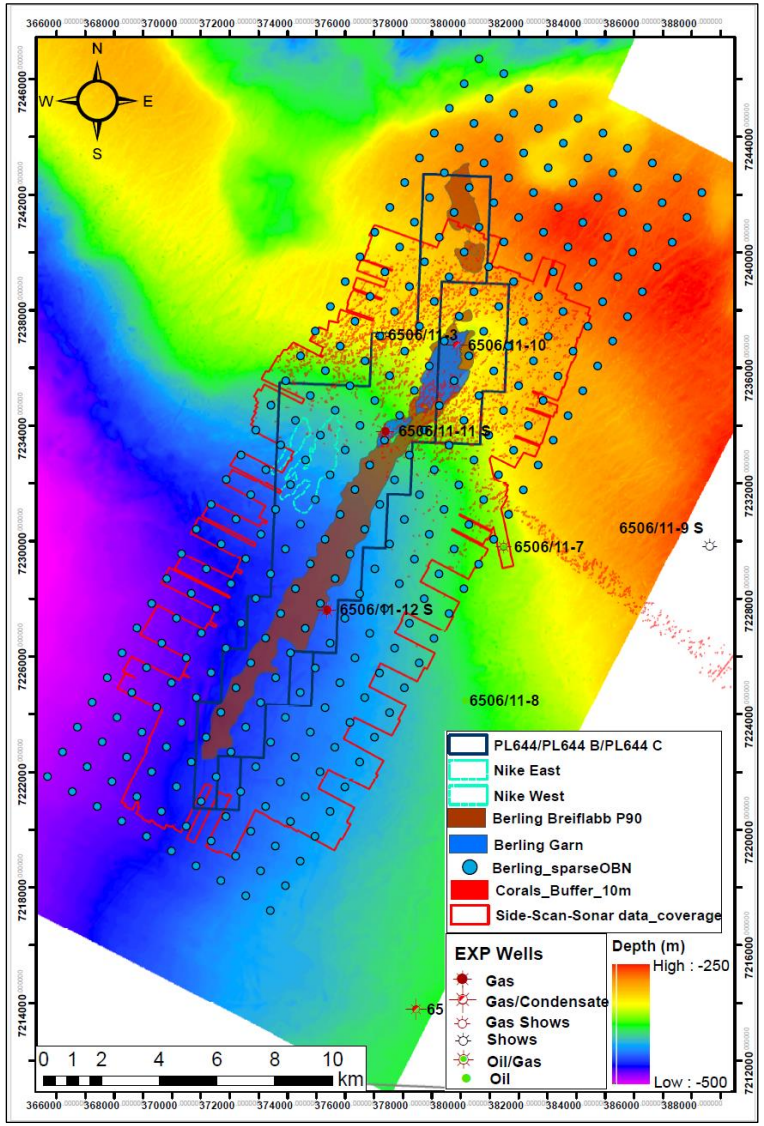
- Ranking of alternative survey designs

What would be the value:

- Optimizing well development planning and risk reduction strategies during drilling
- Maturing upsides

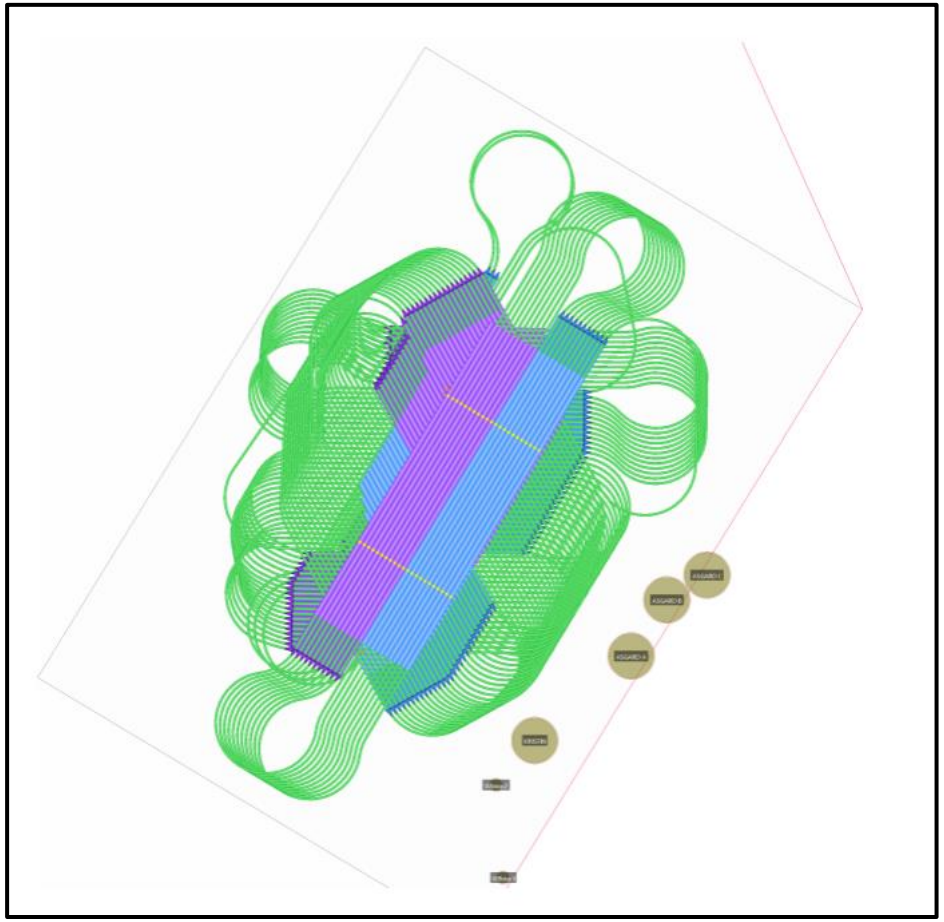
Sparse OBN deployed in cold water coral areas using ROV

- Cold water corals had been mapped in previous site survey work
- After collaborating with DNV and Havforskningsinstituttet, we recommended using ROVs for the deployment/ retrieval of OBN in coral-dense areas
- 300 nodes placed over 300km2 polygon with 1000m x 1000m spacing
- Sparse nodes to record longer offsets for detailed velocity model building



Streamer data acquired in three different azimuths aiming for cleaner data

- Acquisition in three azimuths for improved attenuation of multiples
- Seismic acquisition planned in three azimuths:
  - 31º – full fold areal outline 300 km2
  - 151º - full fold areal outline 593 km2
  - 91º - full fold areal outline 593 km2
- 12 streamers
  - 10 @ 7km
  - 2 @ 10km
- Slanted streamers

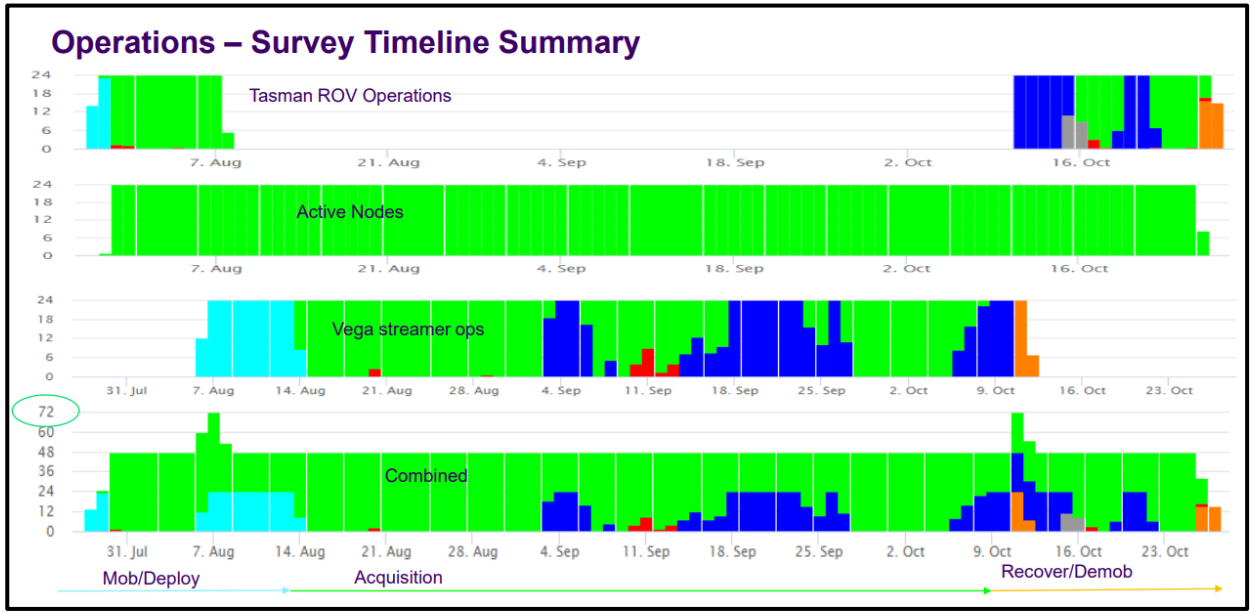


Planning phase - Summary

- Sparse OBN for detailed velocity model for our targets >4km
- Collaboration with DNV and Havforskningsinstituttet on methods to place OBN in cold water coral areas
- Streamer acquisition in three azimuths aiming for cleaner data
- Two longer steamers for improved velocity model building

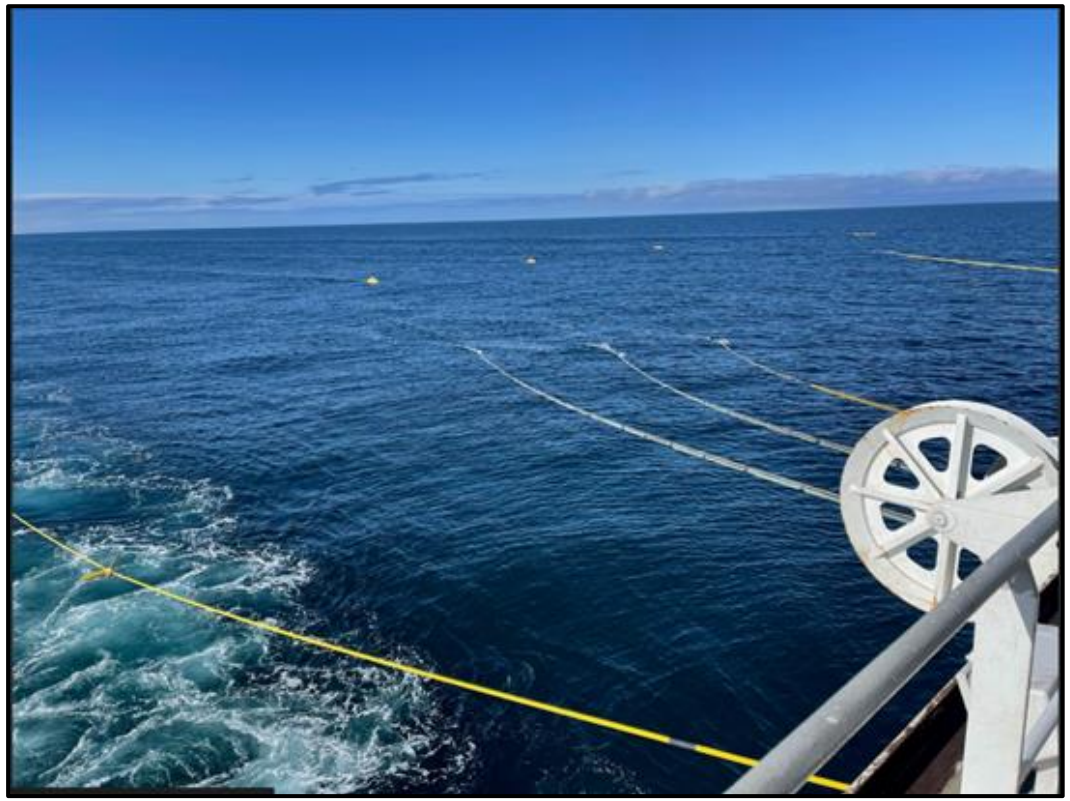
Operational key takeaways

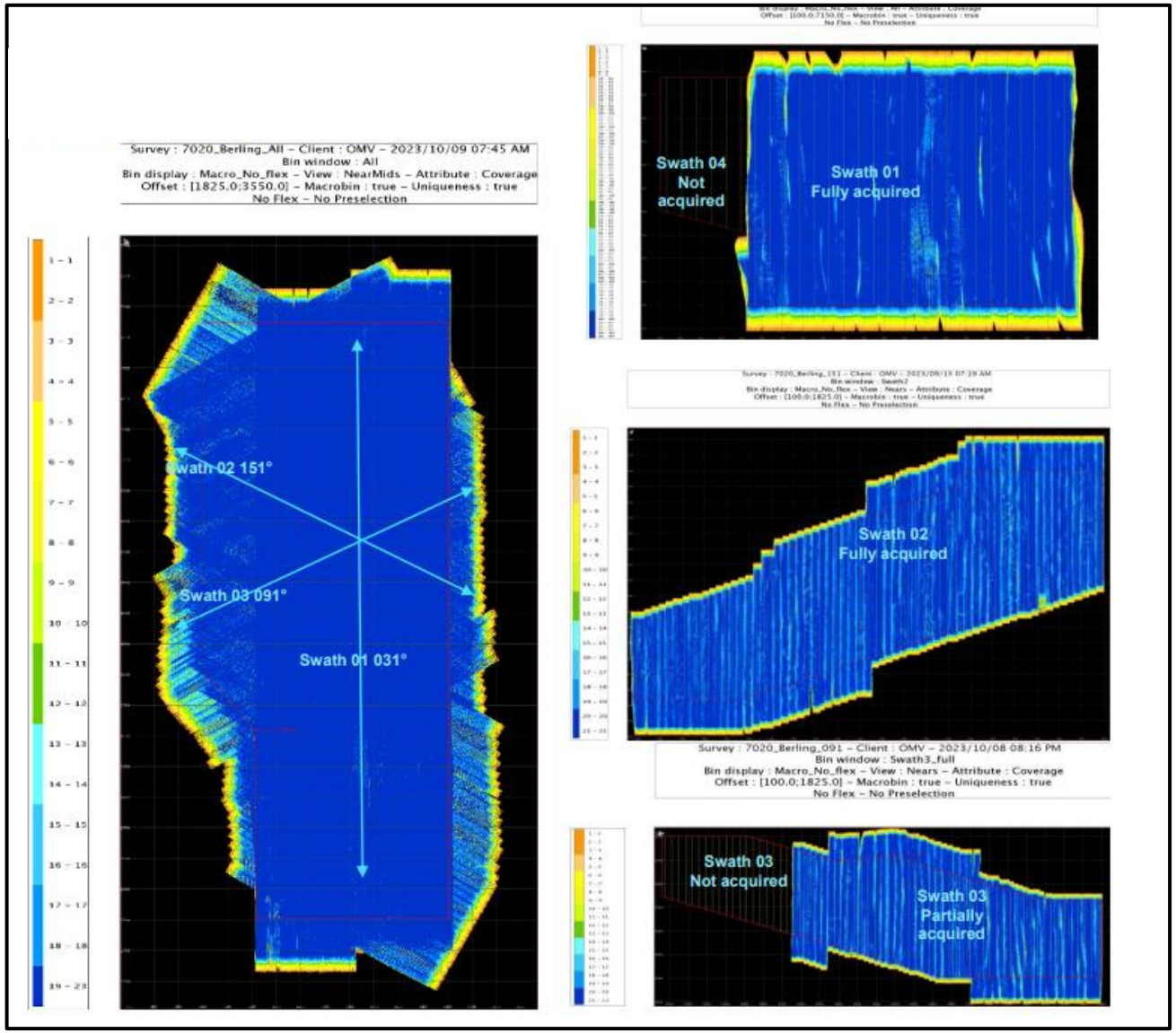
- No HSSE incidents
- Daily calls with OMV project team and client reps
- SIMOPS surprises
- Prioritized shooting plan and infill
- Impact of currents on long streamers



Towed streamer acquisition coverage less than planned but of good quality

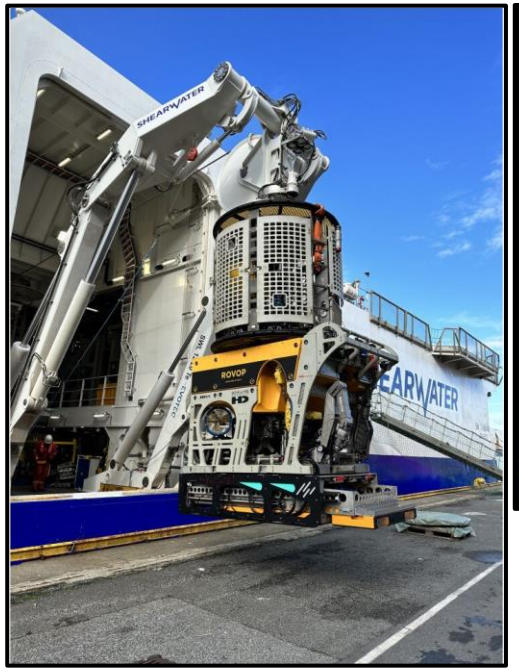
- Overall data quality was very good with some mild industrial noise
- Partly completed due to weather

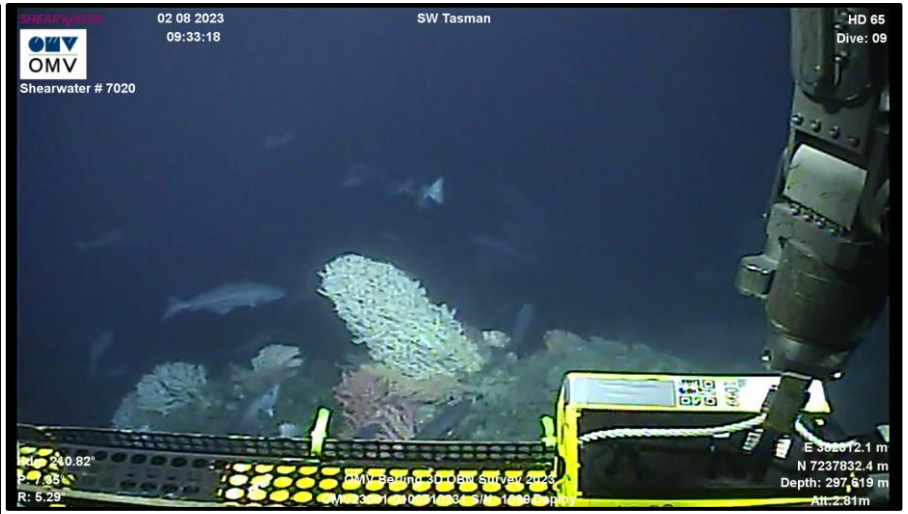




OBN deployment and recovery was an excellent operation

- Cold water corals present on the seabed were not disturbed
- OBN data quality was acceptable with accurate positioning. 1 dead node
- The nodes were generally placed within 3 meters of the desired pre-plot position
- Upon recovery the nodes had moved less than 2 meters overall





Operational phase - Summary

- Daily communication
- SIMOPS
- Priority planning and infills after each azimuth
- Acceptable placements of the nodes
- No corals were touched

Is the technical winner worth it?

- What we want:

→ *Chasing 10m resolution @ target*

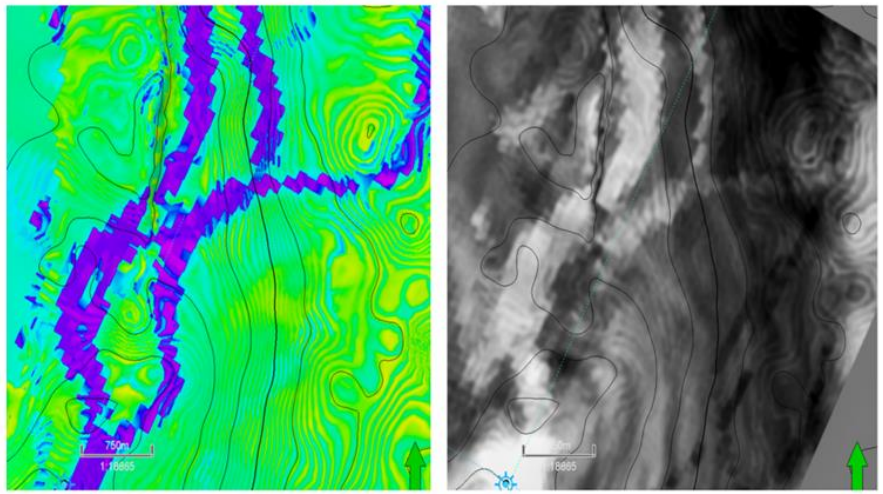
→ *Accurate and detailed fault imaging*

→ *Accurate reservoir facies distribution*

→ *Accurate velocity depth model*

Preliminary results

- *Improved velocity model derived from the longer offset acquired by both the OBN and MAZ data*
- *Early indications of improved definition of faults and structure, especially on the Near offsets*
- *Early indications of improved resolution*

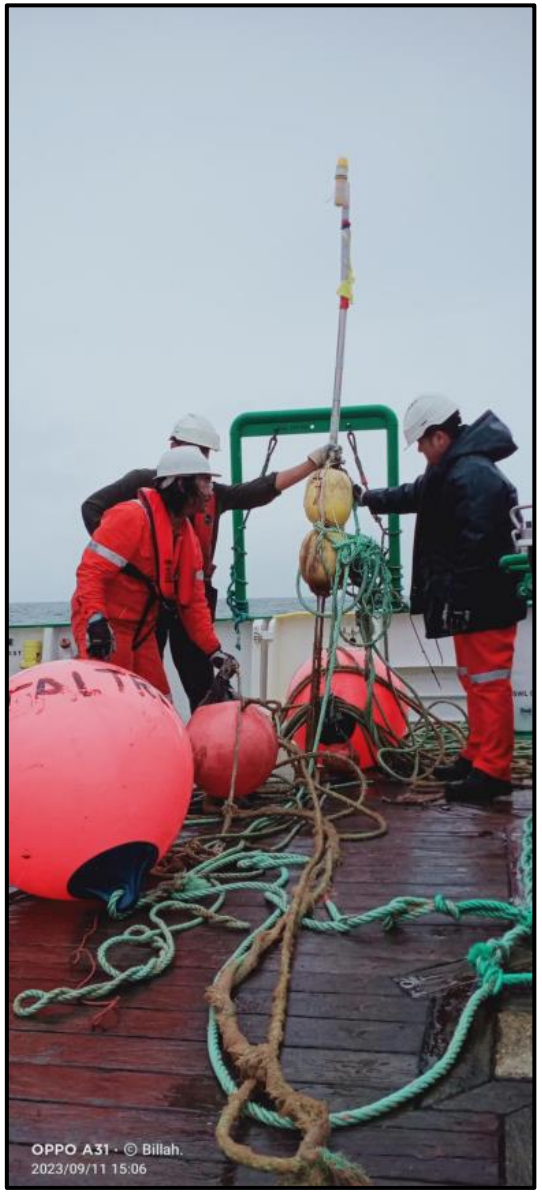


3D Finite difference seismic modelling of a multi-azimuth acquisition geometry, performed on a static model representation of a Cretaceous channel system

← What we want

Summary and Lessons Learnt

- The combined streamer & OBN survey was a successful acquisition
- Deployment/ retrieval of OBN in coral areas is feasible with careful planning
- Although not all lines were acquired, the priority area was achieved
- Significant weather standby. Survey ended due to weather
- SIMOPS surprises from other field operations
- The two longer streamers caused longer turn-times
- Careful planning with prioritization areas deemed to be useful



- 8 Ghost net removals

Thank you for contributing to the success of this project

- JV partners for support, advice and communication
- Openness and cooperation of the onboard client reps
- Expertise, guidance and early engagement from the technical and QHSE support structure within Shearwater
- Commitment from Shearwater project team