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Enhancing Pseudo-3D Subsurface Volumes with Innomar SBP Data for the Development of Offshore Windfarms in Belgium

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Introduction

Context:

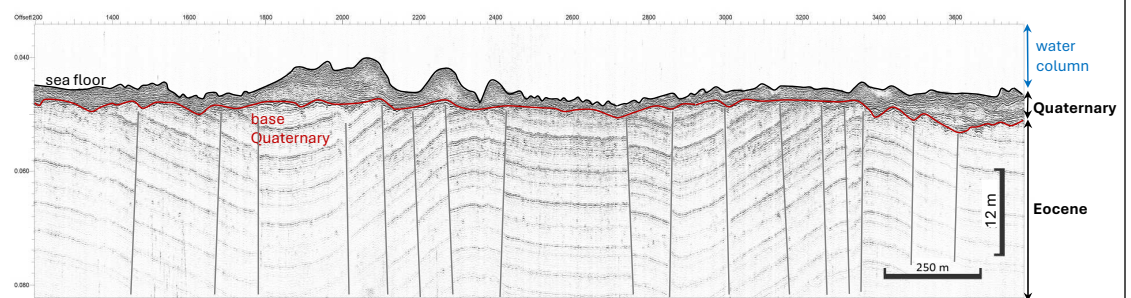
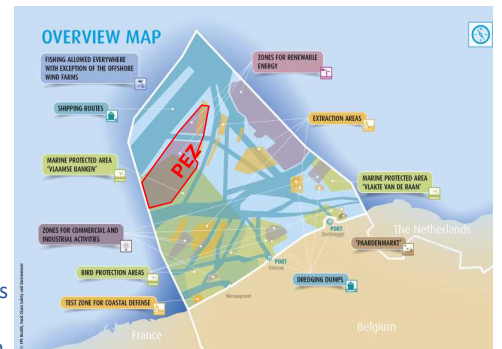
In the Princess Elisabeth Zone (PEZ), on the Belgian Continental Shelf, new offshore windfarms will be built in the coming years.

Geology :

A thin Quaternary cover overlying Early Eocene (Ypresian) clays.

What is the Problem?

Clay tectonic deformations, manifesting as faults and folds, are known to exist in this formation since the 1980's (Henriet et al., 1983; Henriet et al., 1988), yet potential repercussions for the design, installation and operation of the planned windfarms in the PEZ have not been studied so far.

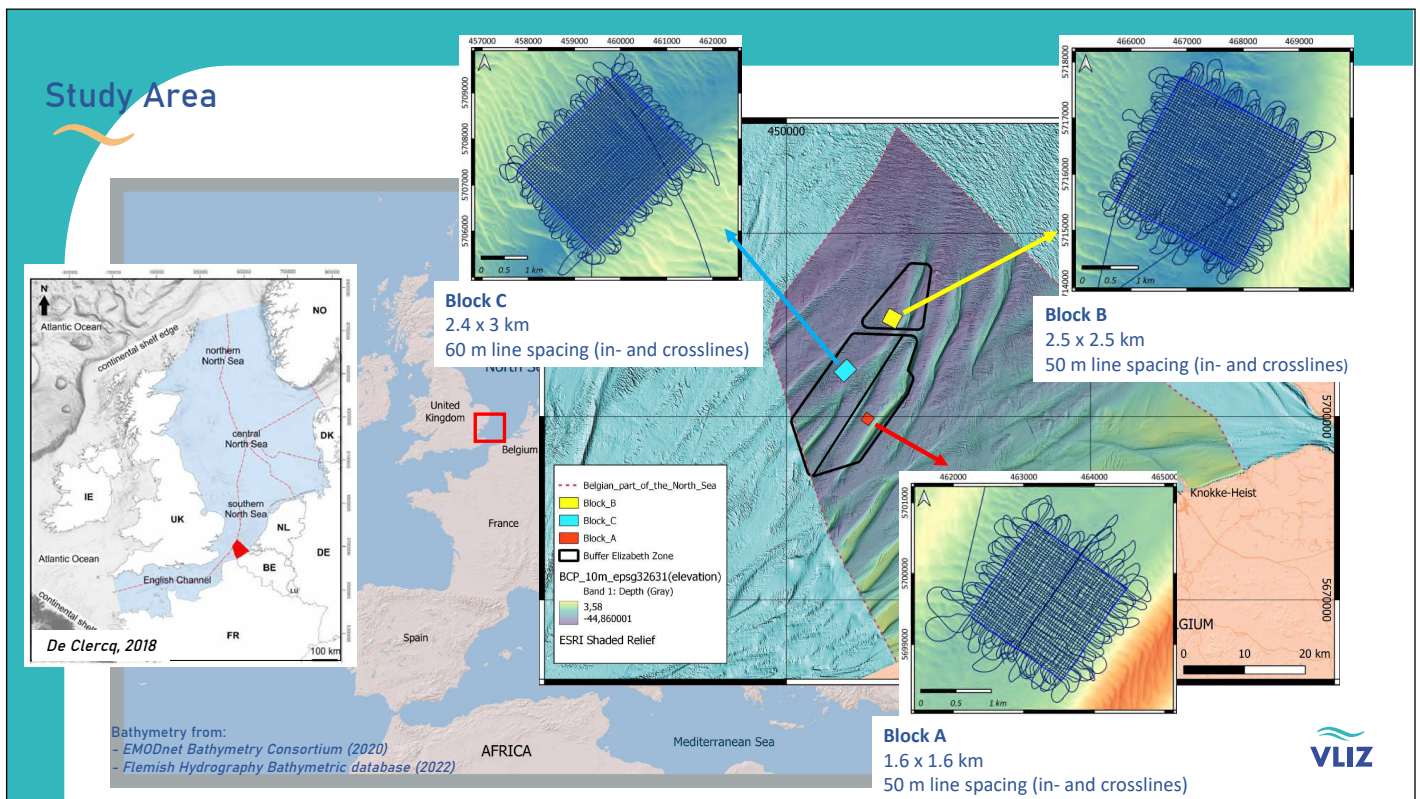


Innomar Quattro SBP profile Princess Elisabeth Zone

Objectives

- **An innovative acquisition approach design**
Cost-Effective & Time-Saving Acquisition
- **Generate pseudo-3D volumes (horizon based)**
from dense 2D seismic data to better visualize subfloor structures.
- **Integrate multi-resolution datasets**
(SBP and sparker) to determine the most effective pseudo-3D approach.
- **Apply attribute analysis**
to highlight faults and other sub-bottom features.



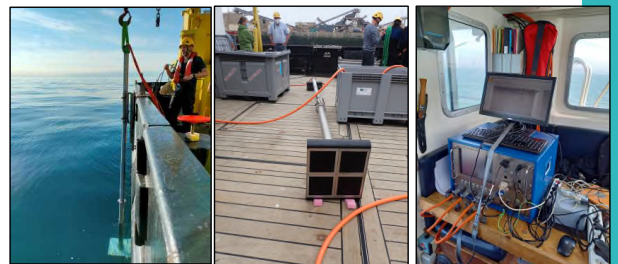


Geophysical Field Measurements

Simultaneous Acquisition of

Acoustic data

- Innomar Quattro System (SBP)
 - Vertical resolution: ~10 cm
 - Shot distance (along-track): ~20 cm
 - Penetration: ~20 m
 - Single beam mode
 - Ping Rate : Auto-optimized
 - Secondary low freq.: 6 khz
 - Trace length: 25 m
 - Gain: 20 dB



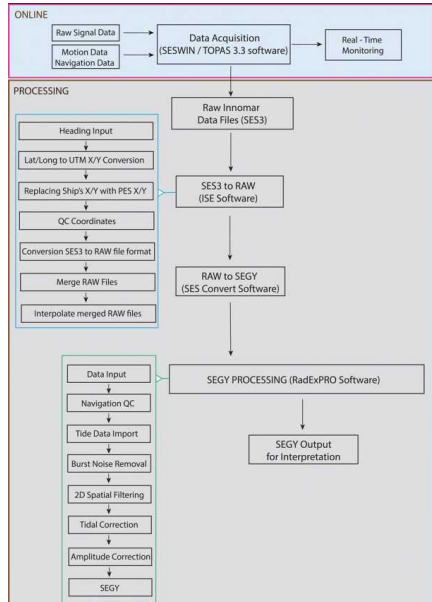
Sparker Seismic Data

- Multi-channel seismic reflection
 - Sparker Source : 4 x 90 electrode
 - Frequency Range: 100-3500 Hz
 - 24 Channel @ 2m group int
 - Shot Interval : ~ 1 m
 - Record Length: 250 ms
 - Sample Rate: 0.125 ms
 - Vertical Res: 0.75 - 1 m
 - Horizontal Res: 1-1.5m
 - Penetration: ~200 m

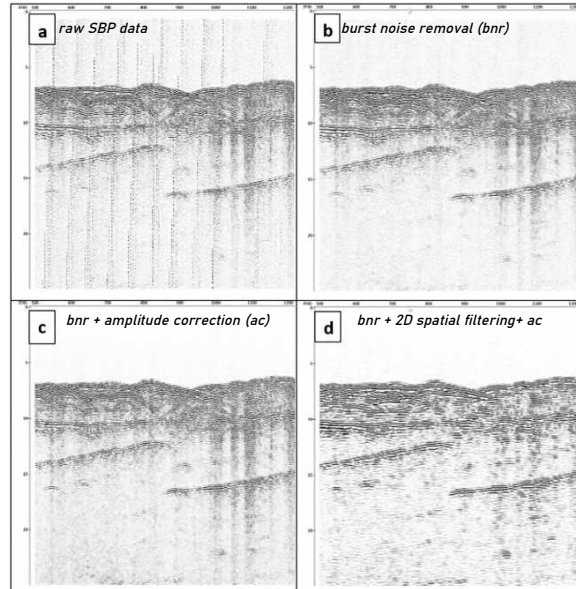


Innomar Parametric Sub-Bottom Profiler Data Processing

Data Processing Flow

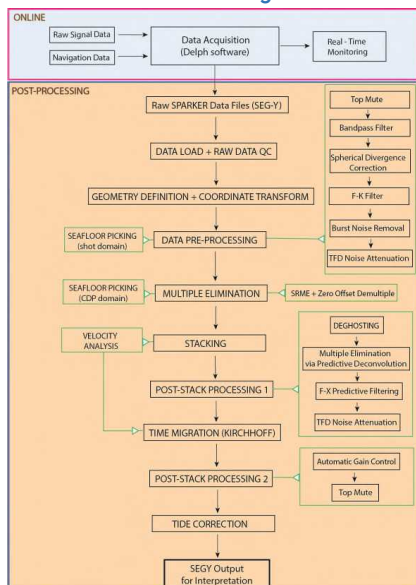


Processing Outputs

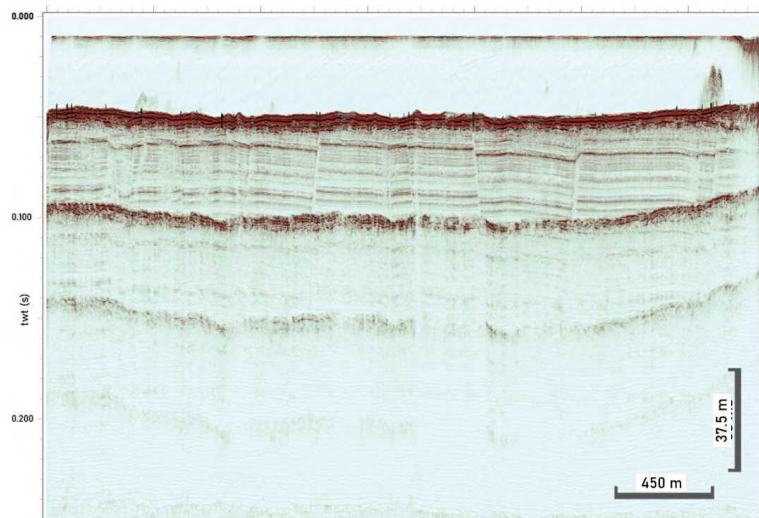


Sparker Multi channel seismic Data Processing

Data Processing Flow

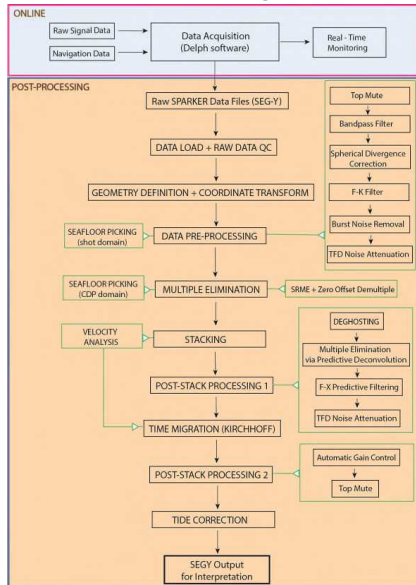


Before Processing

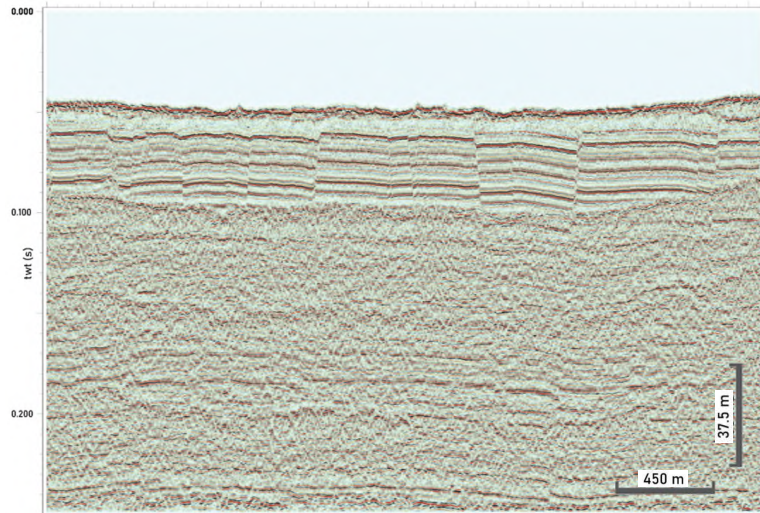


Sparker Multi channel seismic Data Processing

Data Processing Flow

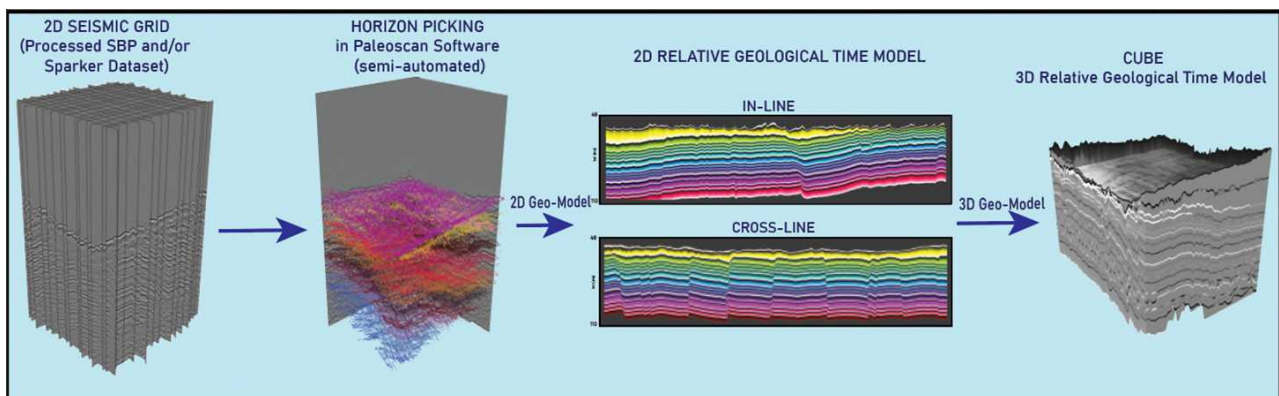


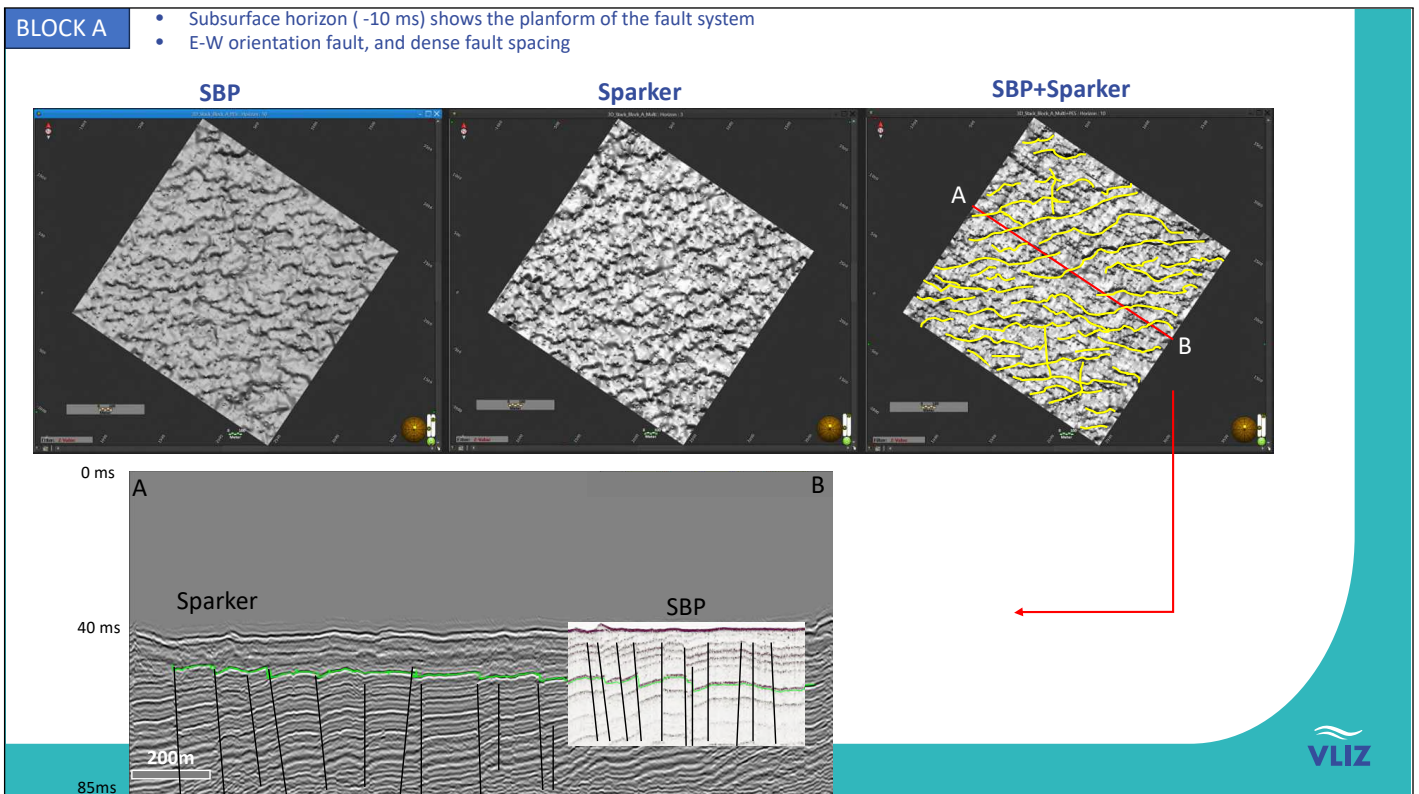
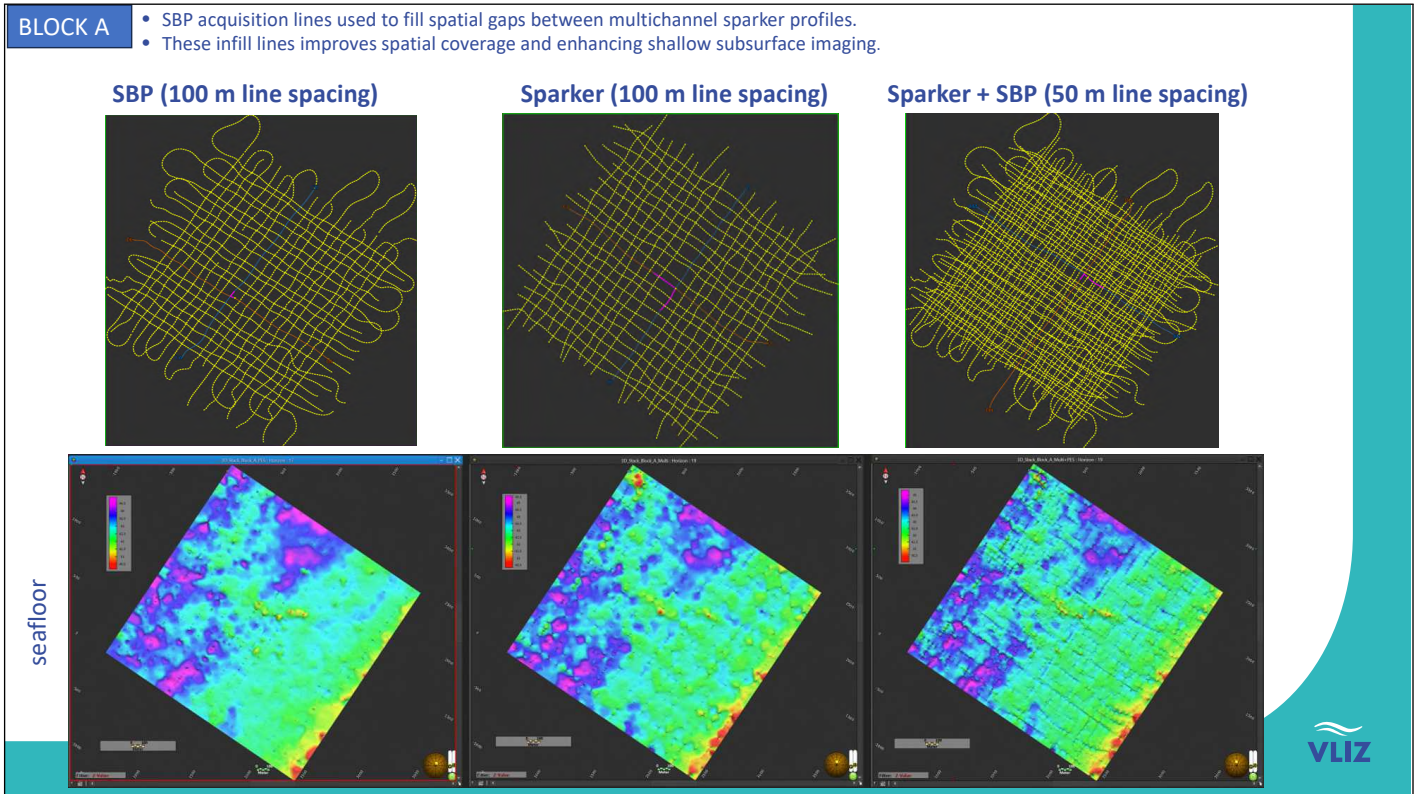
After Processing

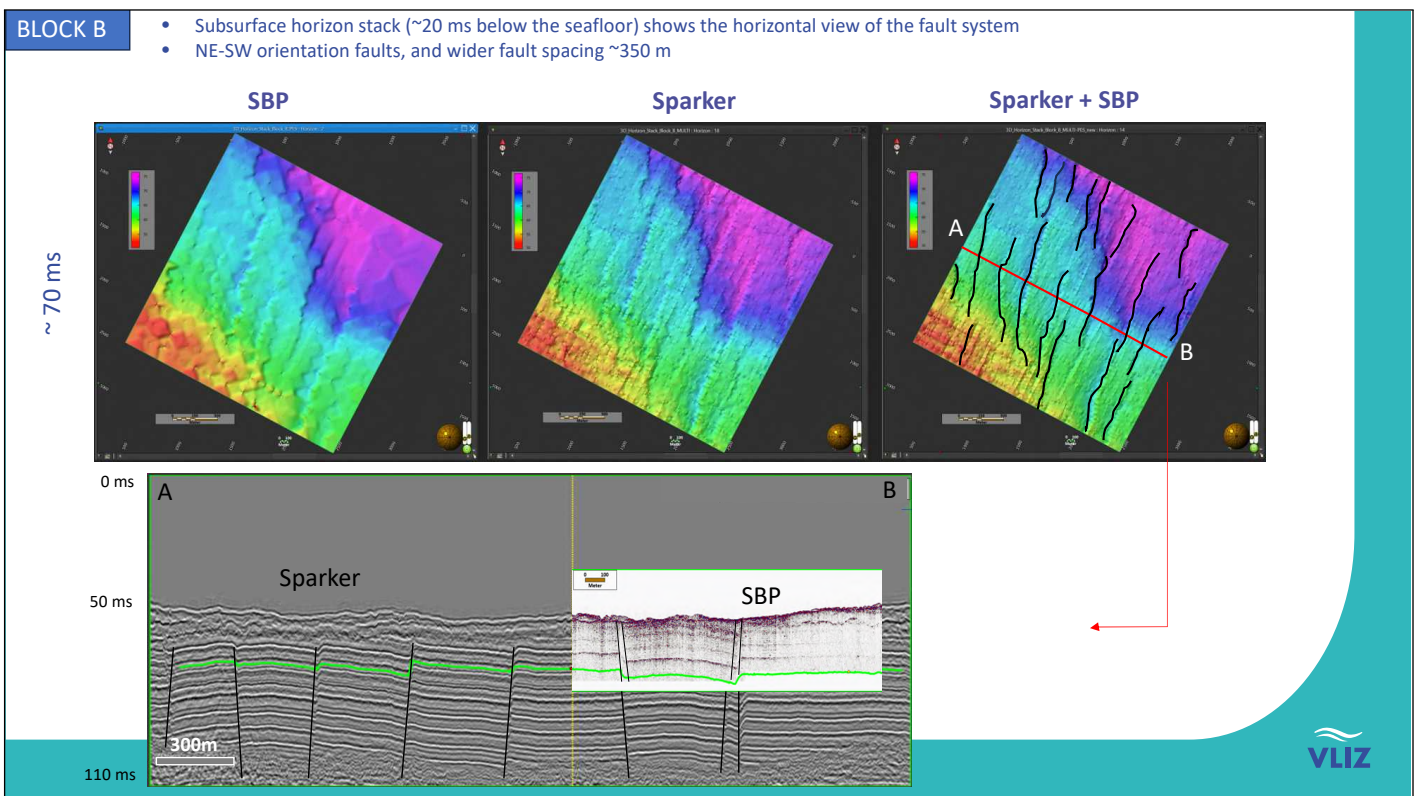
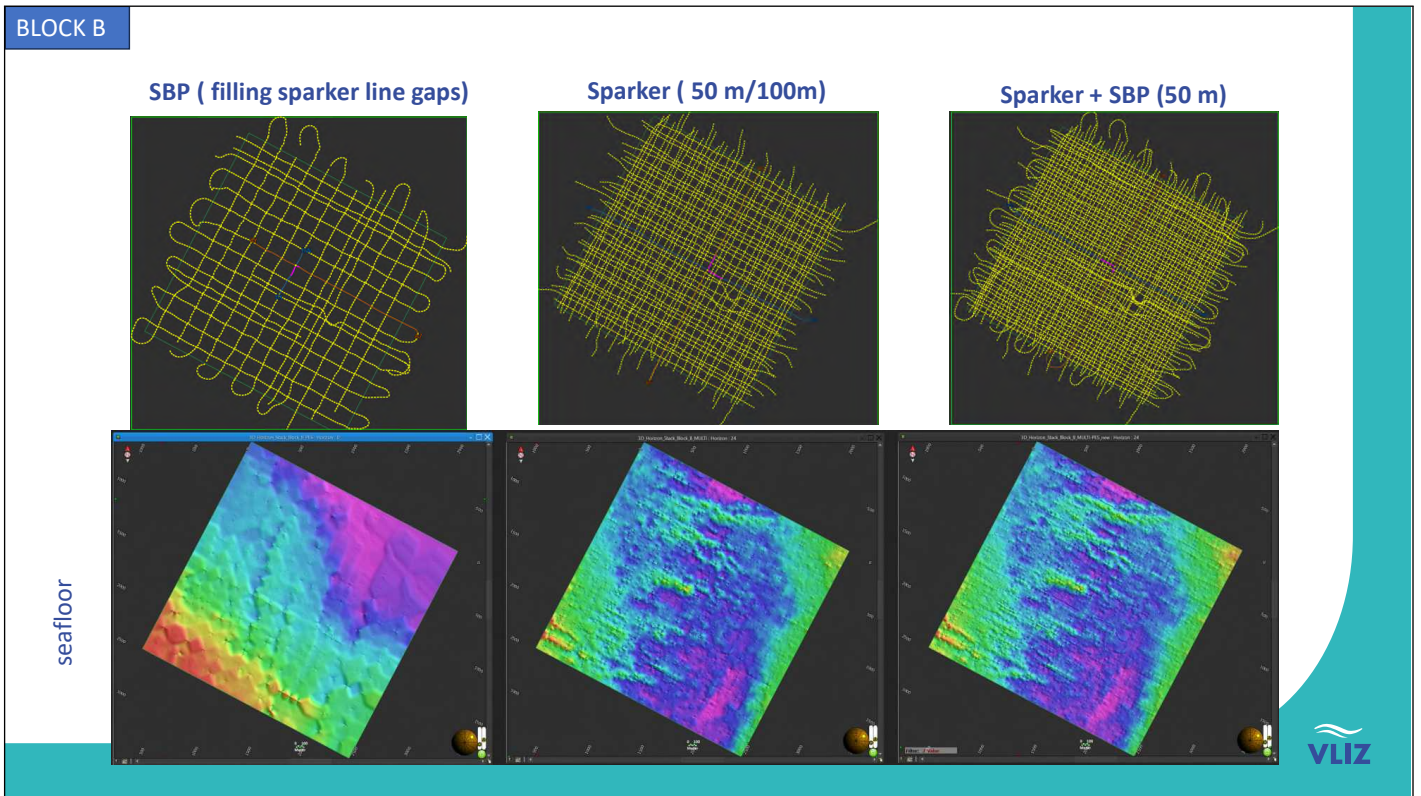


Data integration in pseudo-3D

Pseudo-3D Workflow







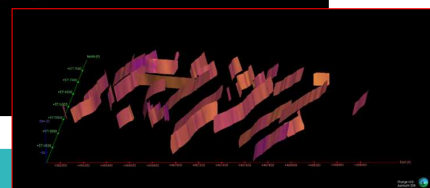
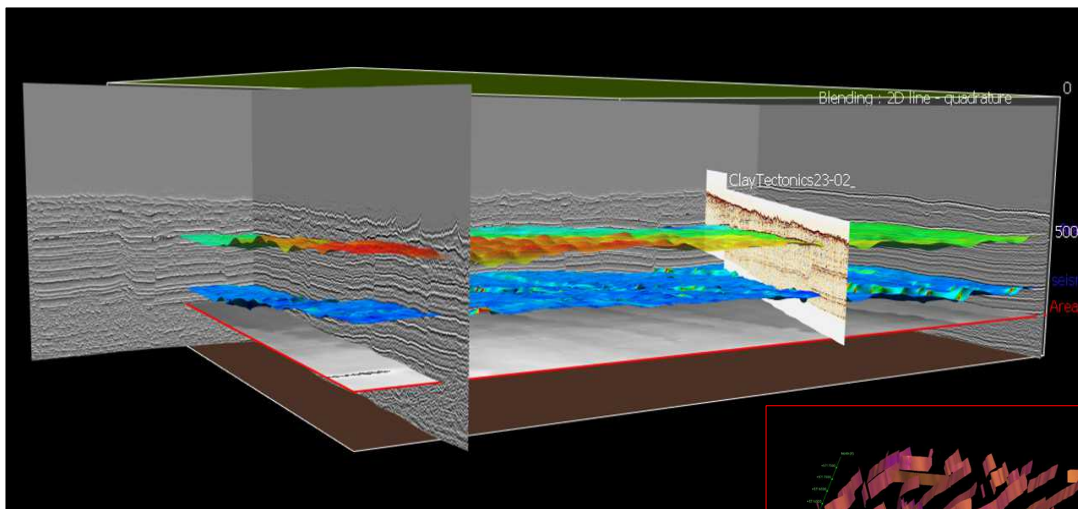
BLOCK B		SBP	Sparker	Sparker + SBP	
Attribute	Contouring				
	Dip				dip attribute describes the steepness of a surface at a Point.
	Dip Curvature				dip curvature describes the rate of change of that steepness (second-order).
Conclusion : Attributes can help to enhance identification of features					



Pseudo – 3D volume

Data Integration in 3D environment:

- 2D profiles (SBP and Sparker Data)
- Horizon Stack (amplitude and attributes)
- 2D RGT Time Model
- 3D RGT Time Model (xline, inline, horizon slice)



RESULTS

- **SBP and Sparker data were complementary**
Integration of both datasets improved near-surface imaging and increased confidence in interpretation.
- **Successful pseudo-3D volumes were created**
Cubes generated through horizon-based interpolation of SBP and Sparker data allow detailed structural interpretation
- **Attribute analysis enhanced interpretation**
Dip, curvature, and coherence attributes helped identify fault orientation, sediment deformation, and lateral continuity.



Thank you!

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LinkedIn contact

Seascapes Past & Future:

www.vliz.be/en/seascapes-past-future

Acknowledgment

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References

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