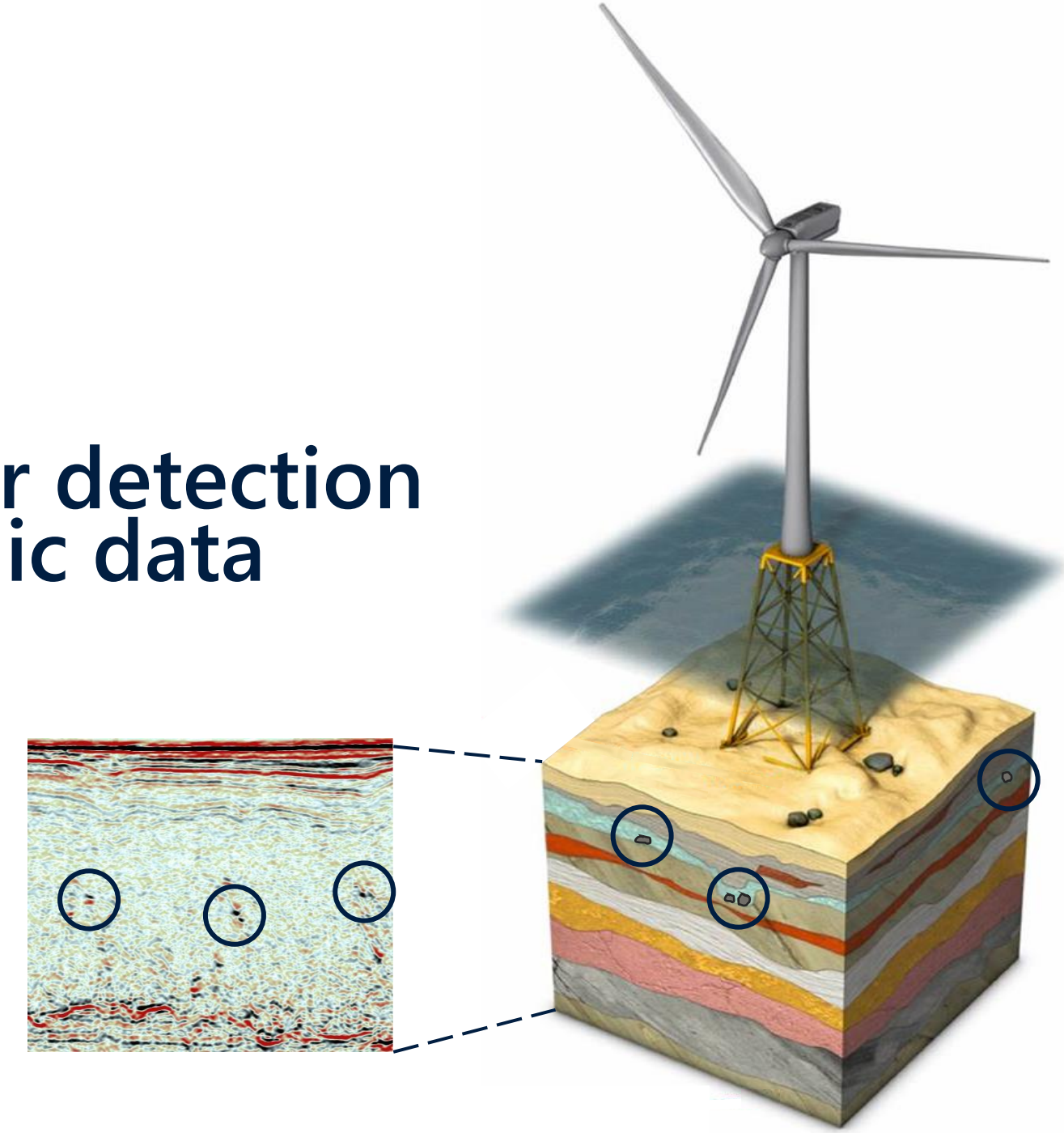
Sub-seabed boulder detection using 3DUHR seismic data

Simon Oakley, Seismic 2021



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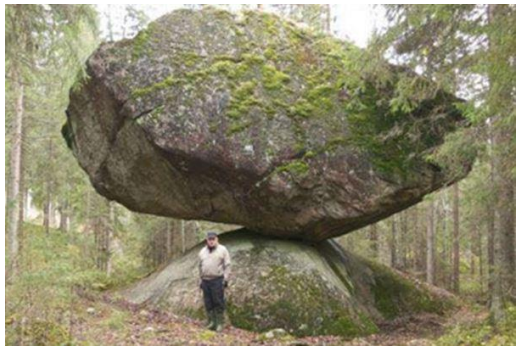
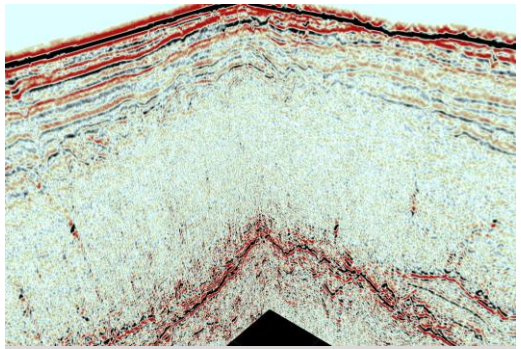
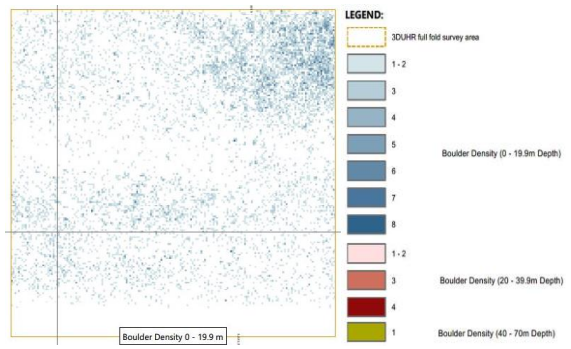
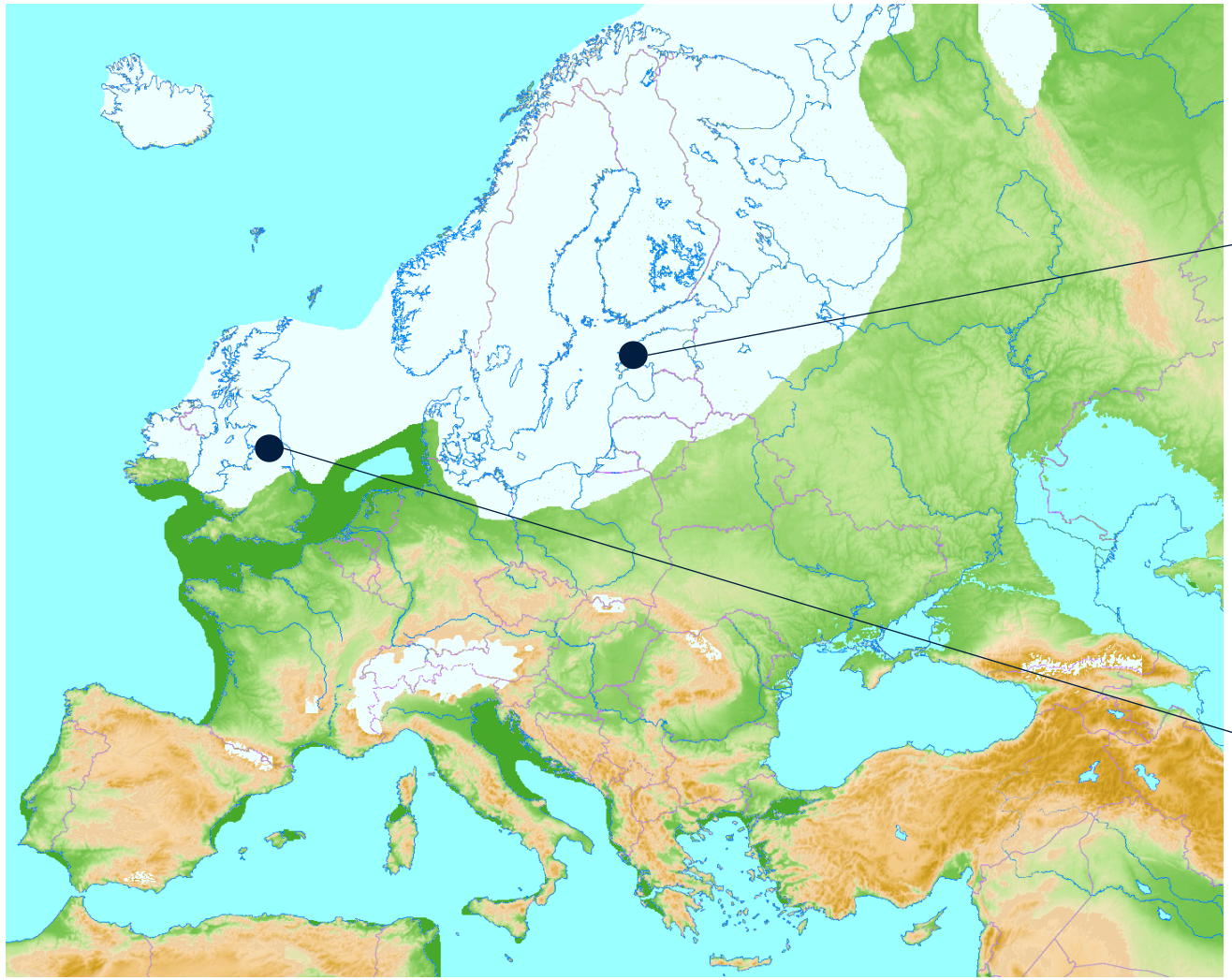




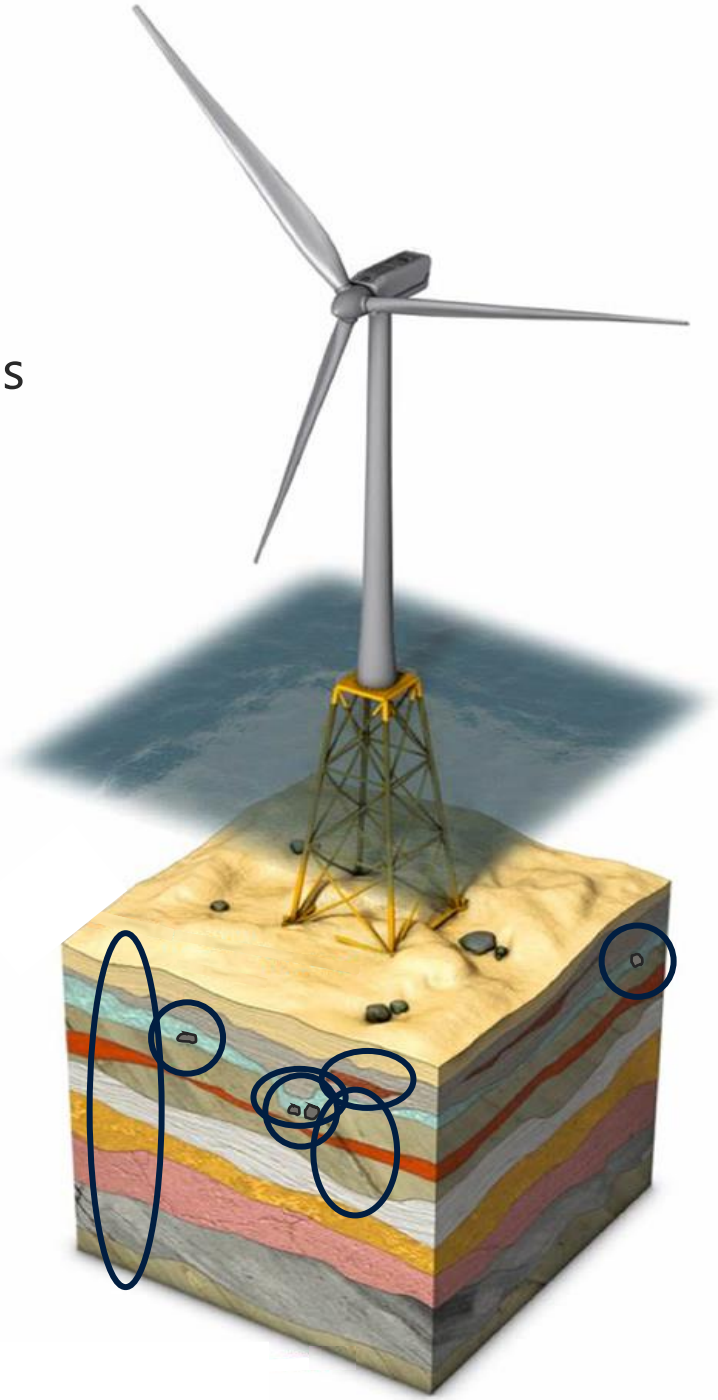


Geological Context



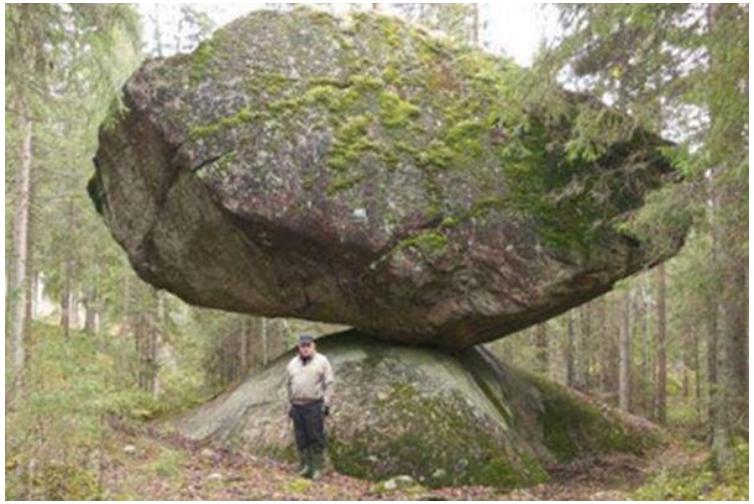
Shallow Geology

- Geology / sediment variations
- Faulting
- Shallow gas
- Channelling
- **Boulders**



Infrastructure Installation

- Shallow geology understanding is crucial.
- Major installation implications.



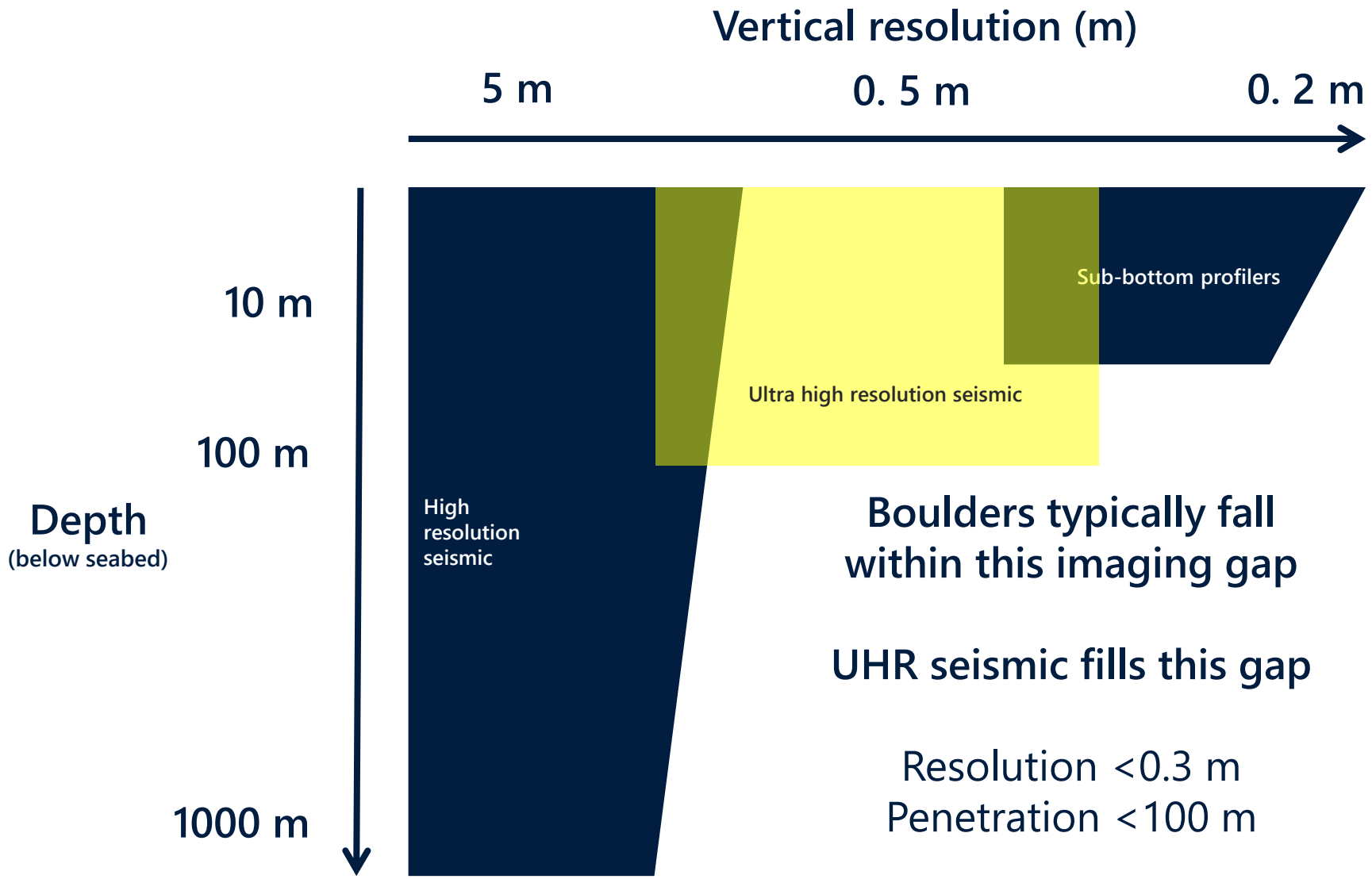
"damage to the pile is a real risk that can occur when the pile hits a hard stratum or encounters objects such as boulders"

Holeyman et al, 2015

"pile refusing on a large boulder was ~10%, with refusals most likely in the upper 25 metres"

Aldridge et al, 2010

Imaging Requirements



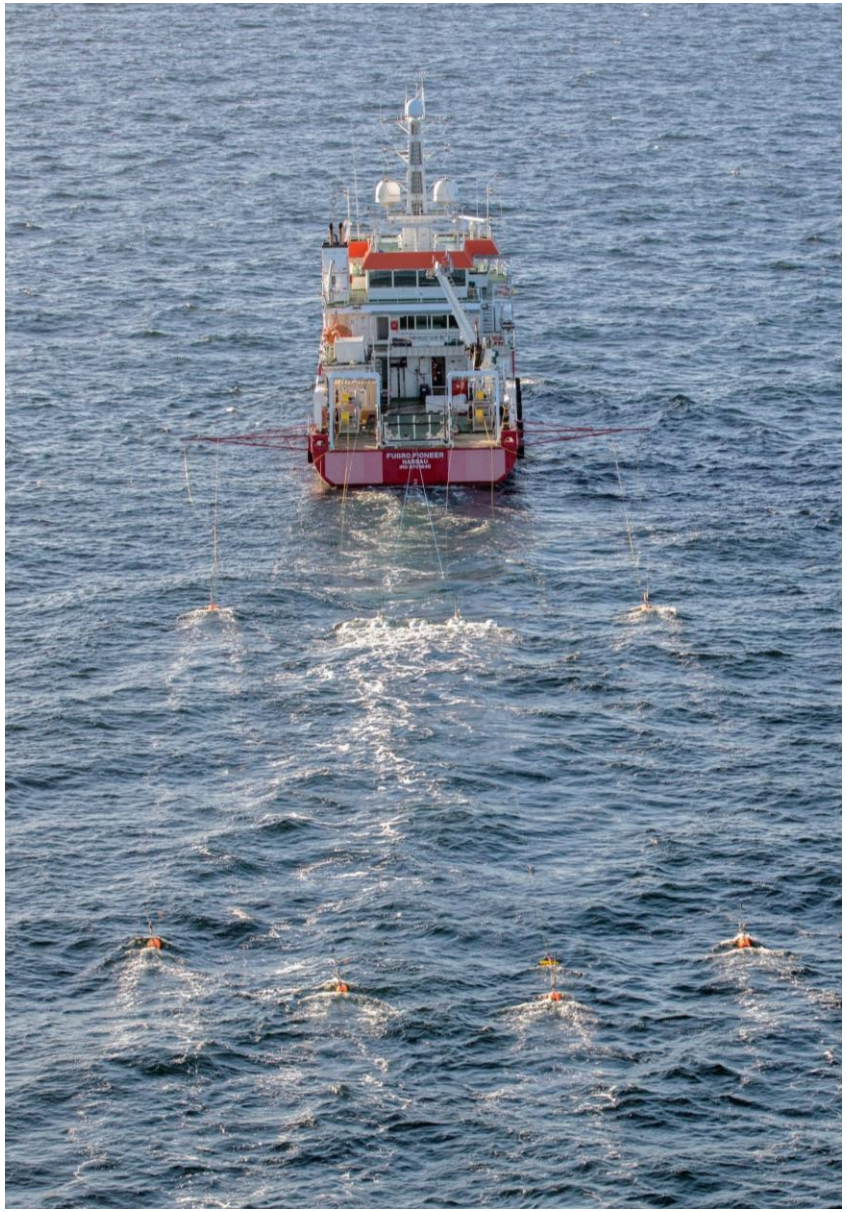
Boulders typically fall within this imaging gap

UHR seismic fills this gap

Resolution <0.3 m
Penetration <100 m

Acquisition Methodology

- Multi-level stacked sparker sources.
- Multi-channel streamers with Fugro adaptative drogues.
- Acquisition bin size 1.0m by 1.0m
- Setup is customisable and versatile.



Processing Methodology

- Proprietary source and receiver deghosting.
- Proprietary source and receiver statics compensation.
- Much improved signal bandwidth.
- <0.5m vertical resolution in very shallow section (<50m sub-seabed)

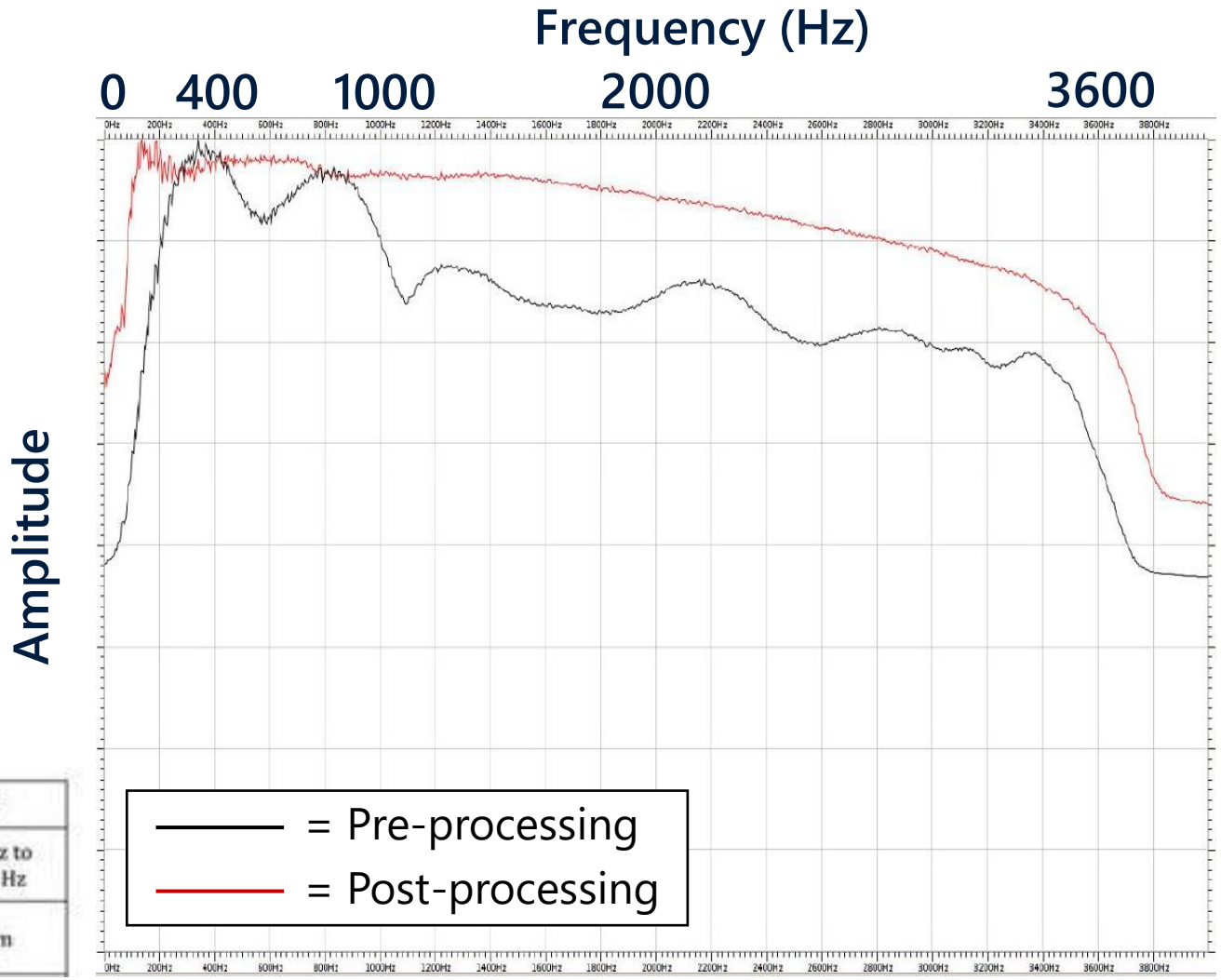


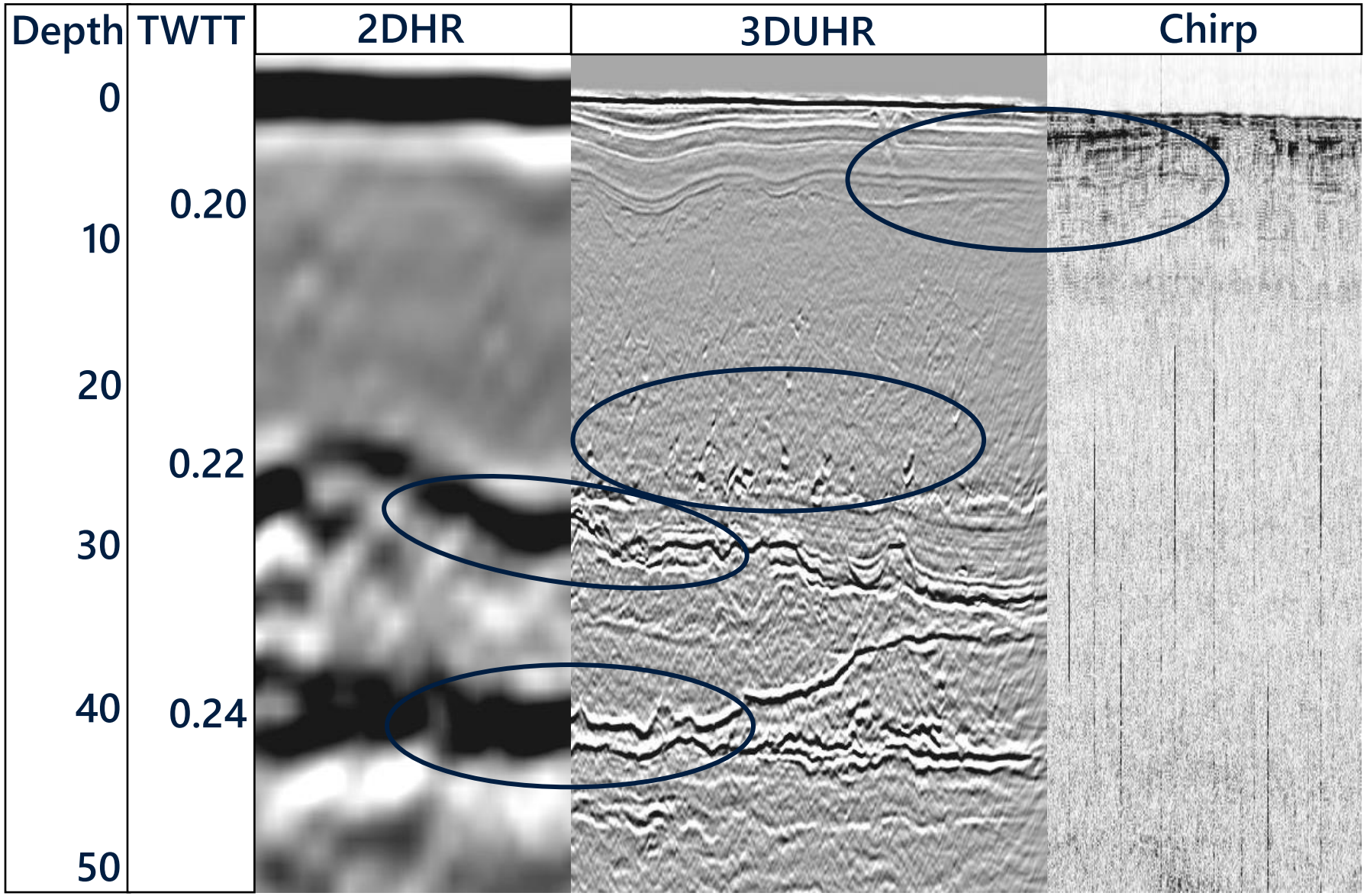
Table 14 — Typical specifications for seismic reflection methods

	HR	UHR	UUHR	SBP
Target range for dominant frequency	75 Hz to 300 Hz	250 Hz to 800 Hz	750 Hz to 2 000 Hz	1 000 Hz to 15 000 Hz
Expected vertical resolution range (approximate) [a]	1 m to 7 m	0,5 m to 2 m	0,2 m to 1 m	< 0,5 m

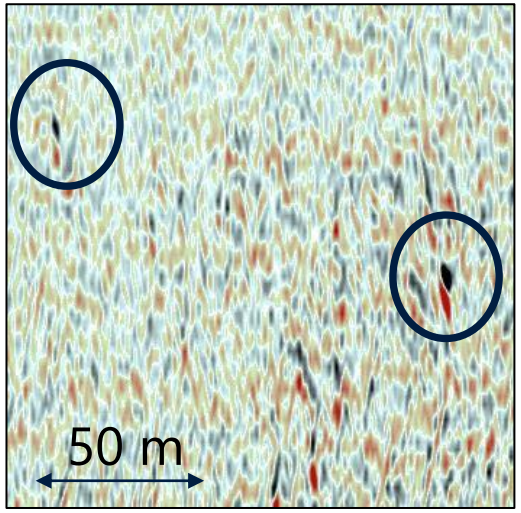
UUHR+ ???

ISO 19901-10

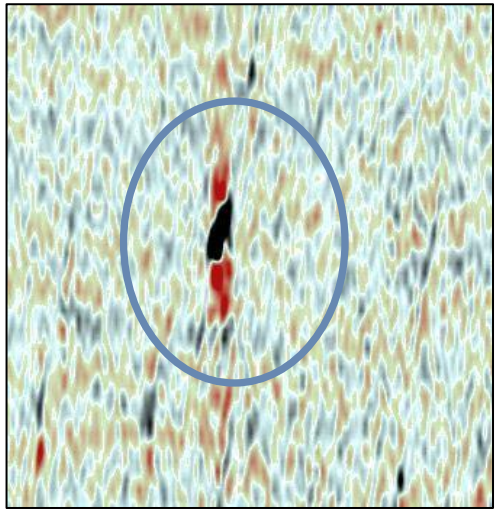
UHR Data



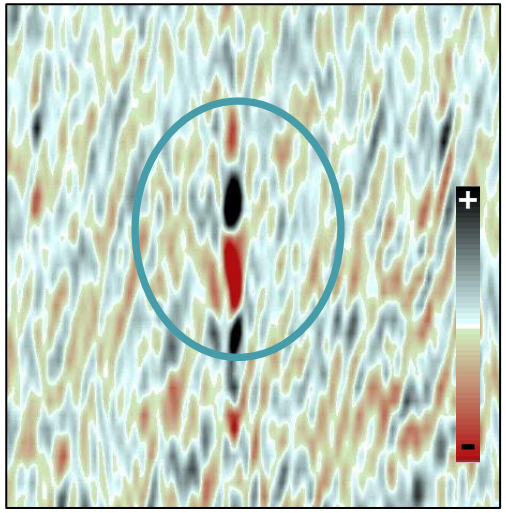
Interpretation Methodology



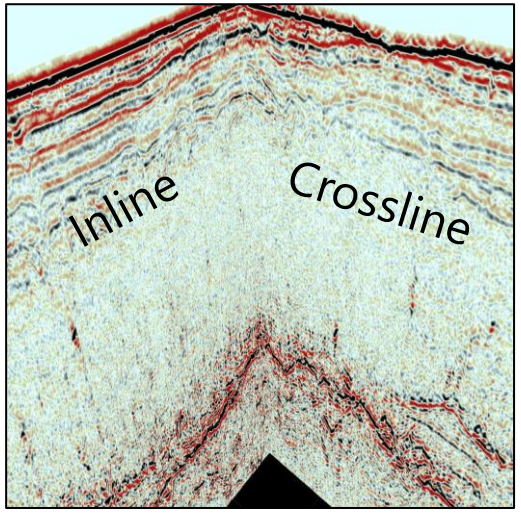
Very discontinuous reflectors



High amplitudes

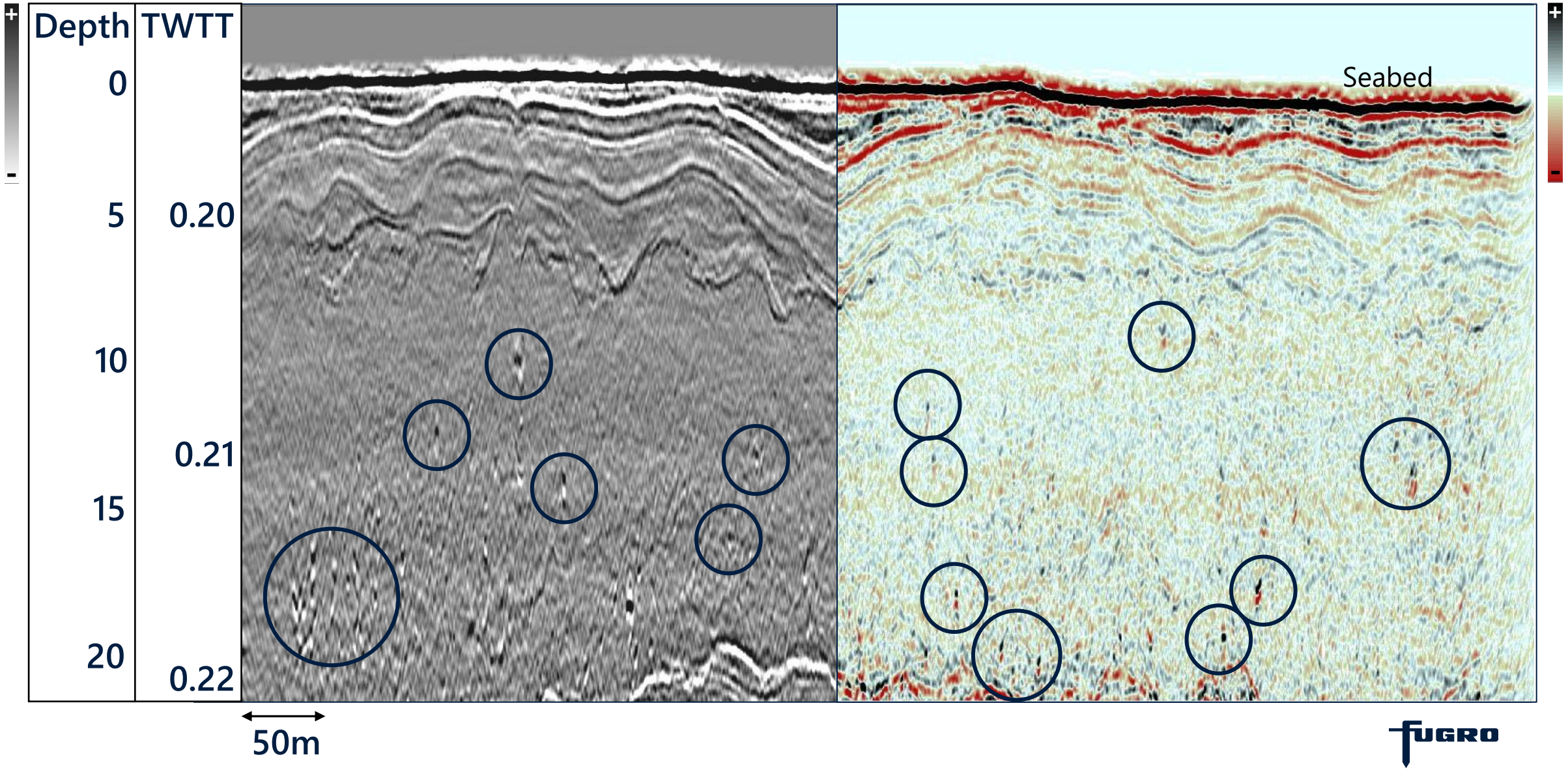


Normal polarity



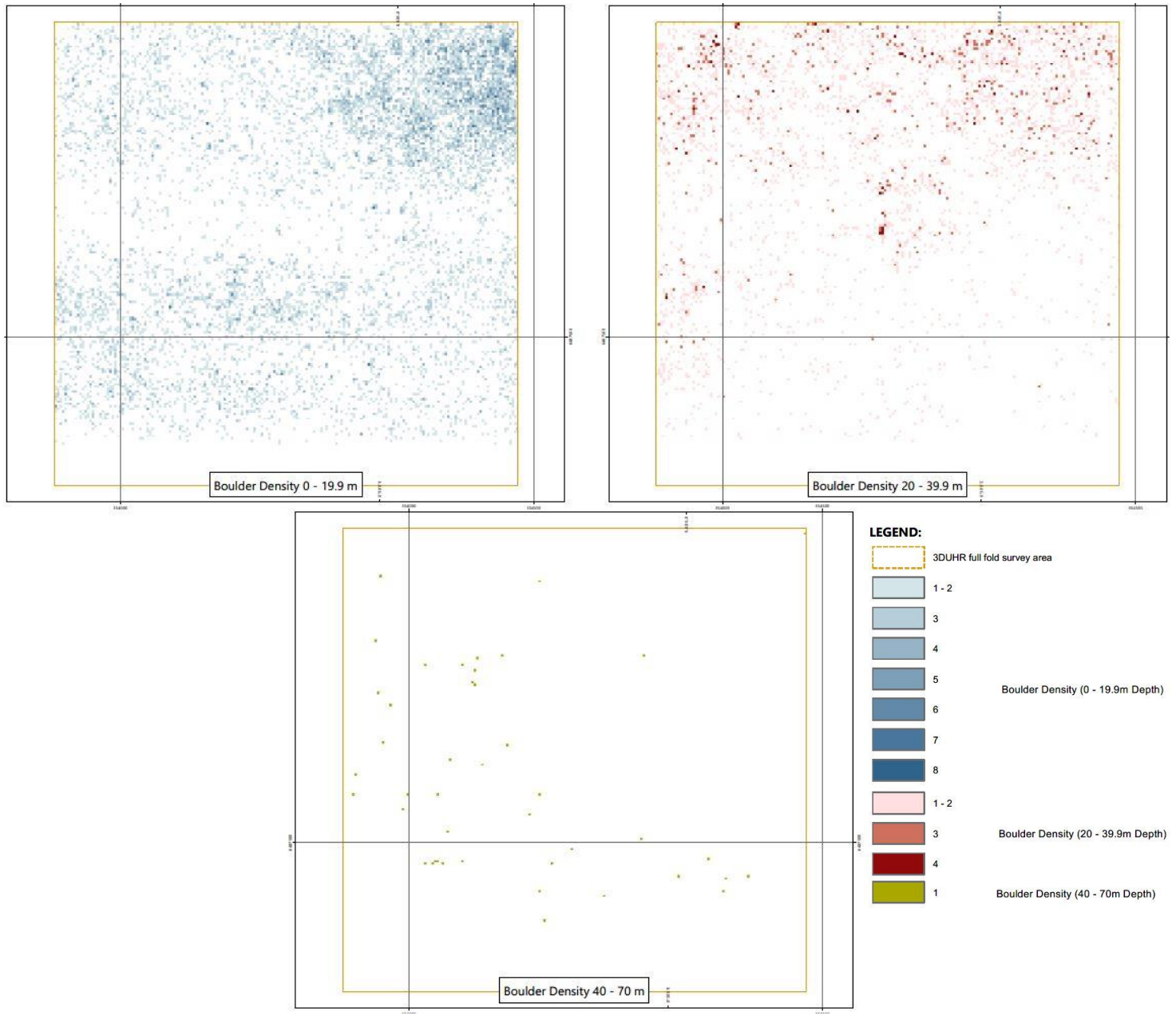
Inlines used for primary interpretation

Boulders

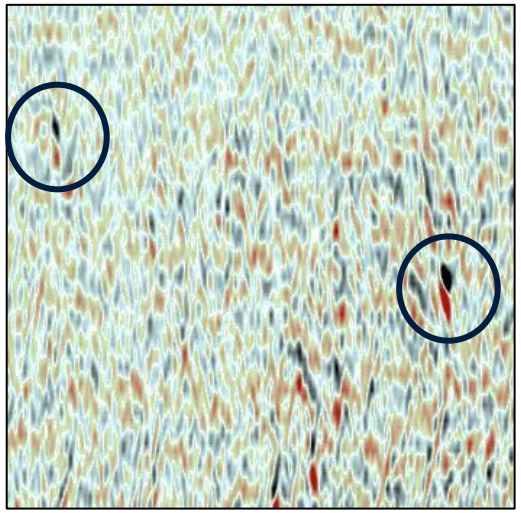


Results

- Results typically displayed as boulder density.
- Coloured boulder density charts.
- Information can be configured to specific depth ranges.
- Product delivered in GIS format.



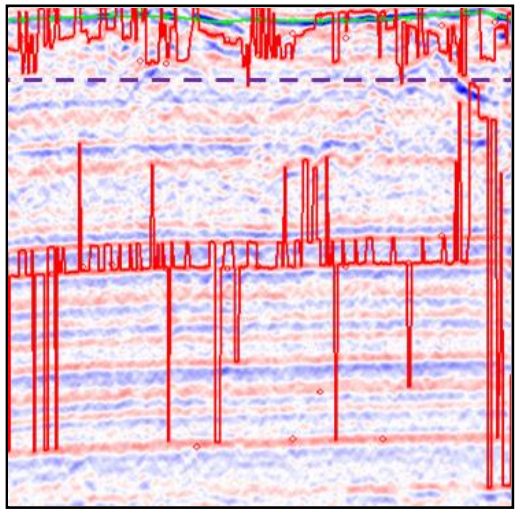
Interpretation Methodology - Work In Progress



Manual interpretation

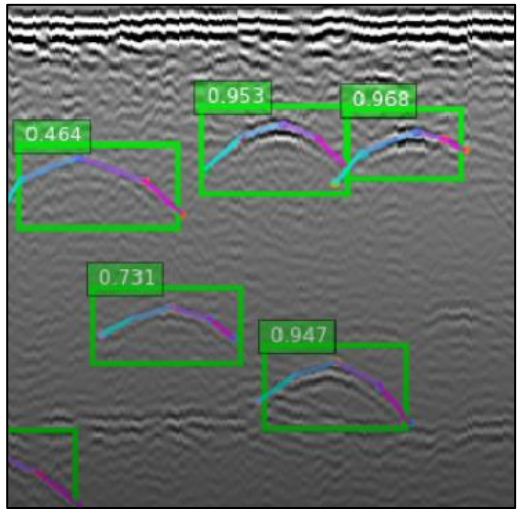
Time consuming

Repetitive



Volume attributes

Semi-autonomous



Machine learning

Fully autonomous
Requires significant feed data

Conclusions

- Reduced risk of project delays and costs.
- 3DUHR solution.
- Boulders 0.5 - 5.0m+ in diameter can be identified.
- Boulder density charts and GIS.
- Machine learning.

Thank you

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References;

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