Shallow Hazards

Fagdag brønnkontroll 2025

19th of February 2025

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GEO PROVIDER

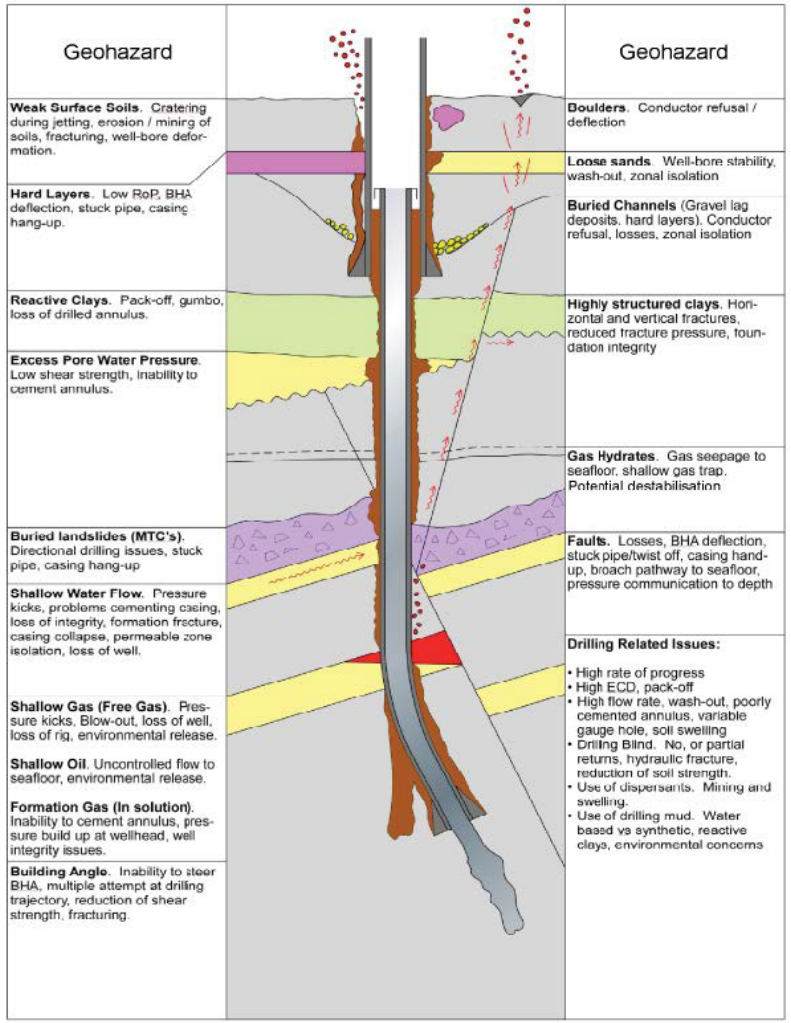
Shallow Hazard Events on the NCS

- Still a challenge in 2025? YES

- Why?
  - Hazard not detected – very common with SWF
  - Hazard underestimated - e.g. during pilot hole drilling
  - Unexpected combination of problems

- Can we do something about it? YES

Main Challenge



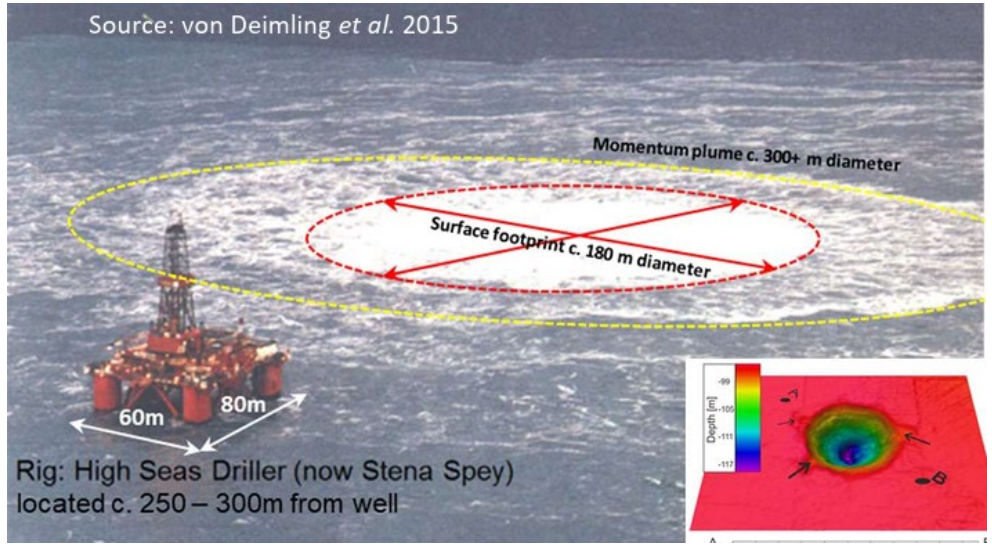
1. Shallow Gas
2. Shallow Water Flow
3. Wellbore Stability & Losses

Or a combination of 1, 2 & 3

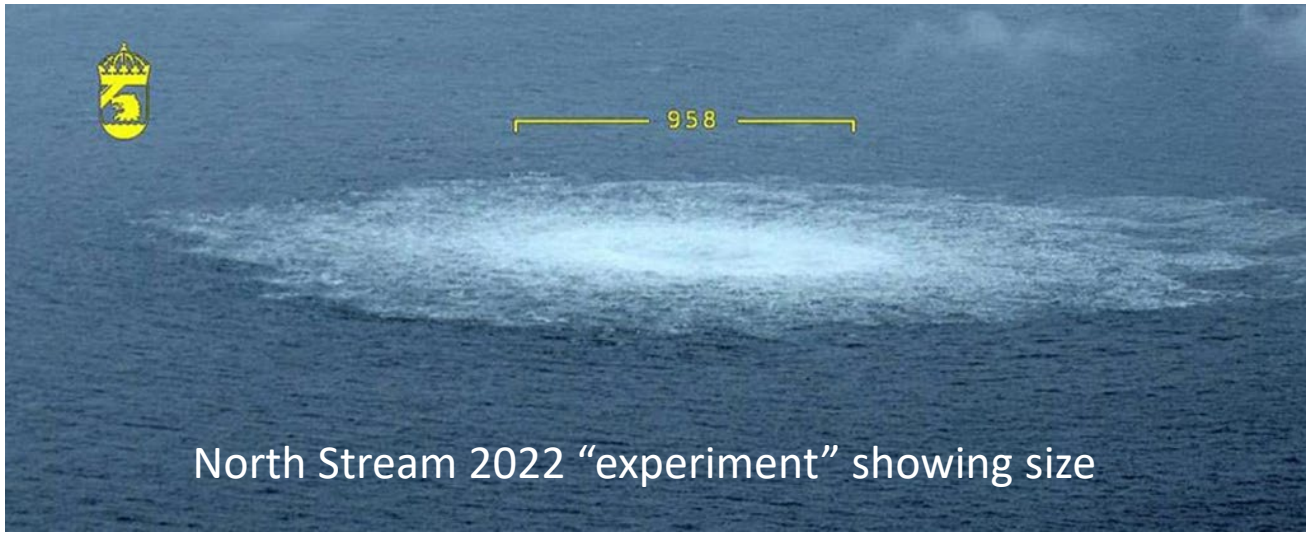
- Shallow gas & shallow water flow = shallow pressure problem

- Limited or no well control barriers

Just a reminder



- 22/4b-4 blowout in 1990
- 20 m x 70 m crater
- Still leaking today



- Real life analogue of a heavy gas blowout
- 5 nautical mile safety zone

How to get better in 5 steps

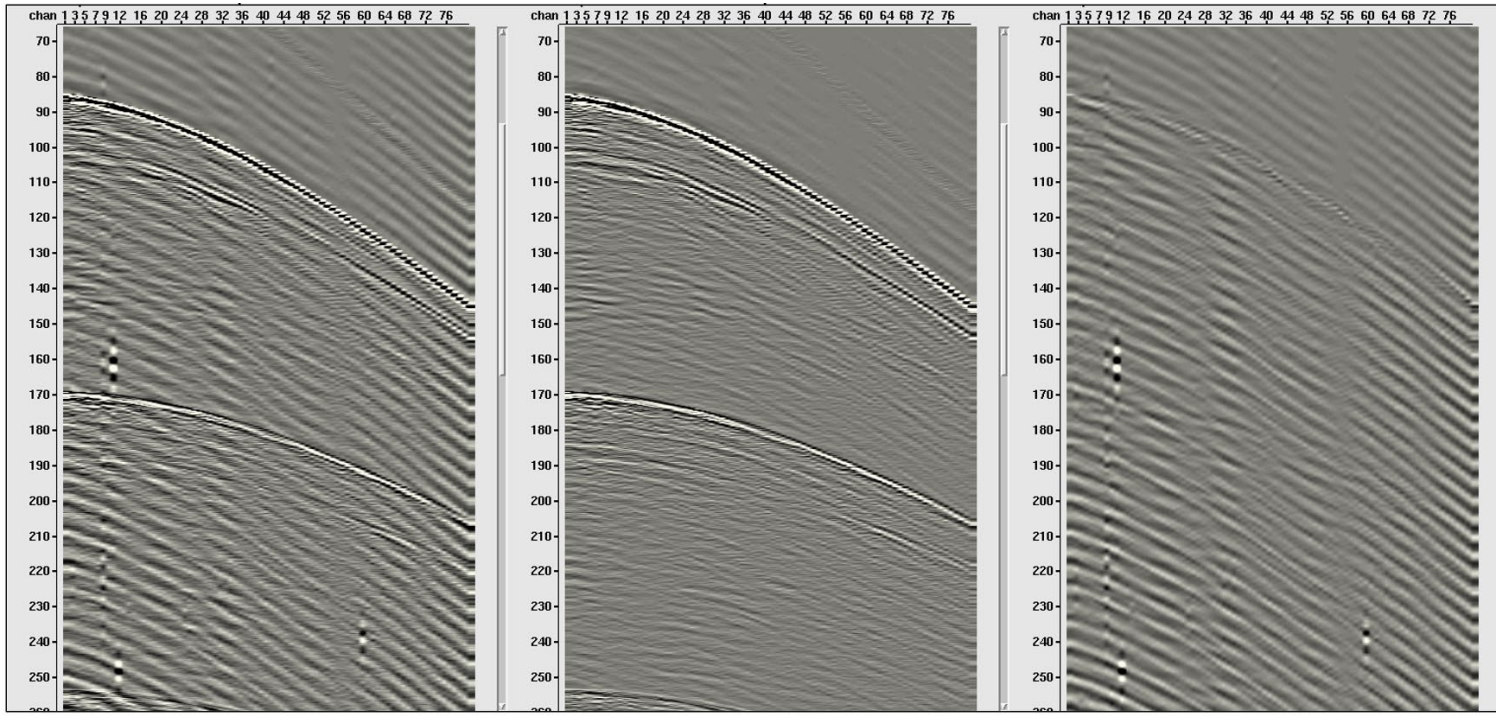
1. Acquire good site survey data
2. High Resolution Processing
3. Integrate ALL subsurface data = IOGP Best Practise
4. Use seismic attributes & AVO
5. Don't forget other Geohazards

<u>Avoid</u>, prepare & mitigate

⇒Avoidance is the cheapest & easiest option

1 - Acquire Good Site Survey Data!

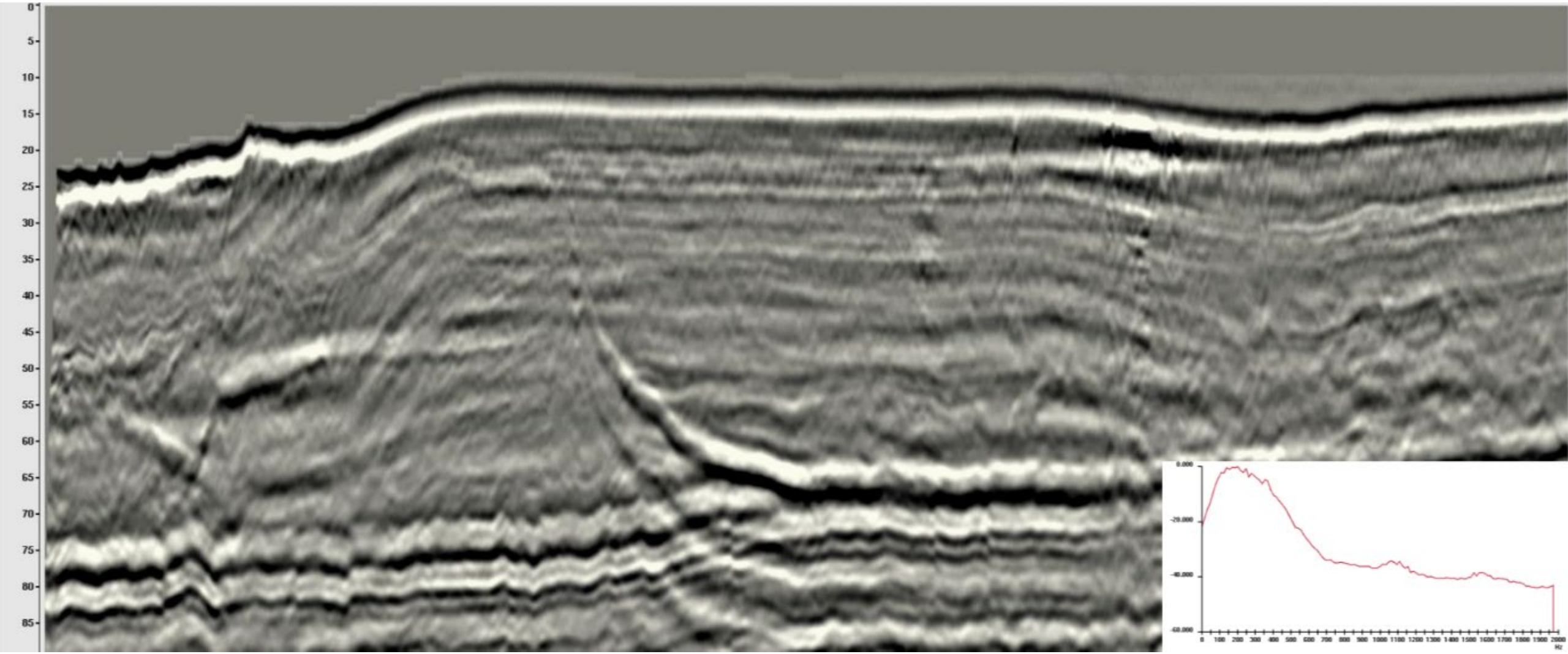
2022 Original Data **After Noise Removal** **Noise Removed**



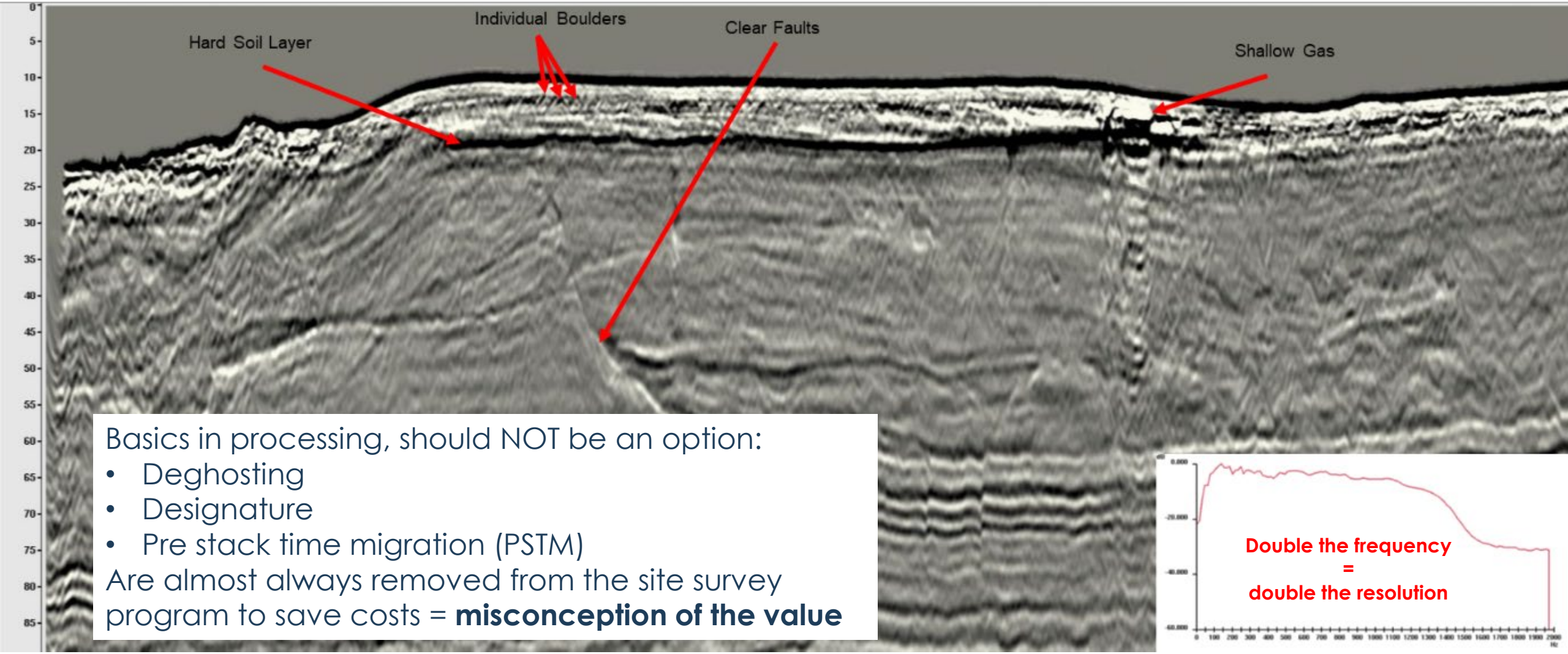
Key Learnings

- Use **experienced Client Reps** to QC quality offshore
- **Process offshore** processing to check the quality during acquisition
- **Avoid bad weather** if you can for geophysical data acquisition – waste of time to collect bad data
- Use **high resolution processing techniques ("Broadband")**

2 -Improve Resolution – Classic Data



2 - Improve Resolution – Latest Techniques

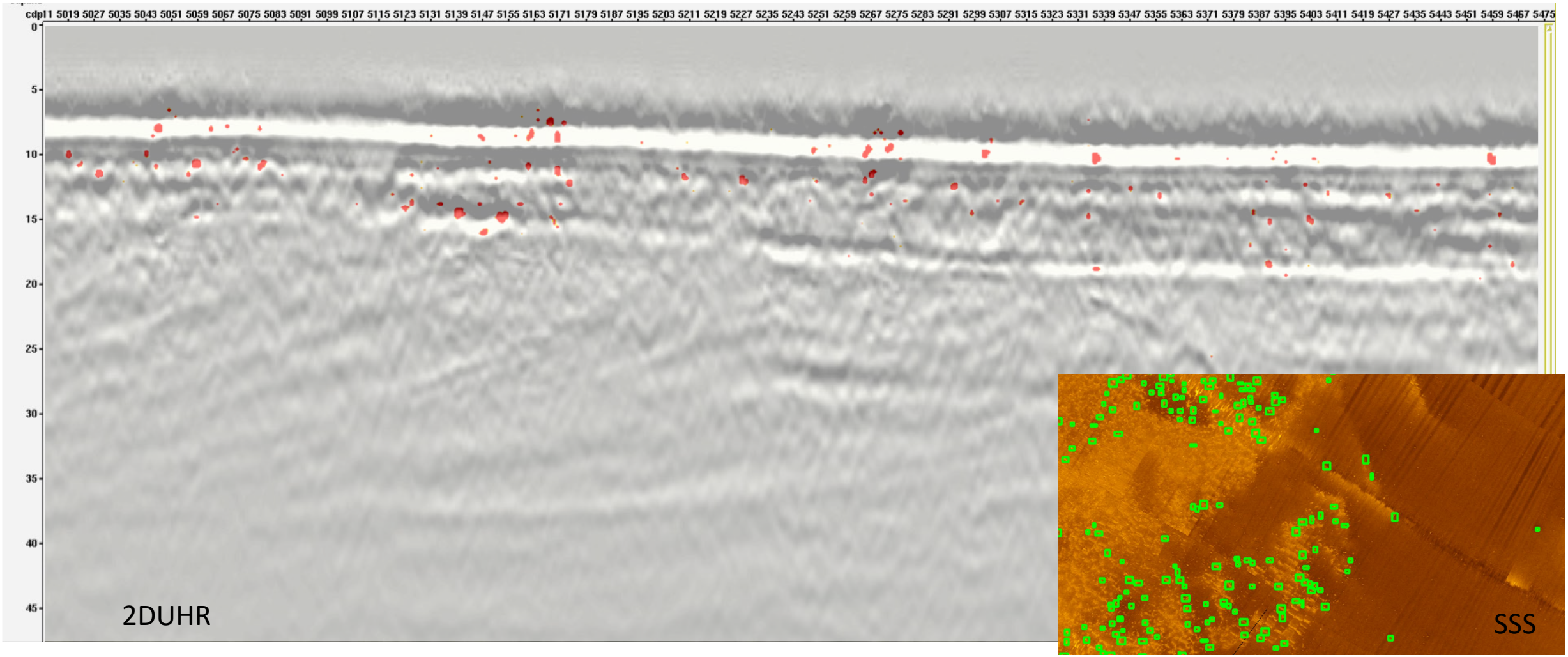


Basics in processing, should NOT be an option:

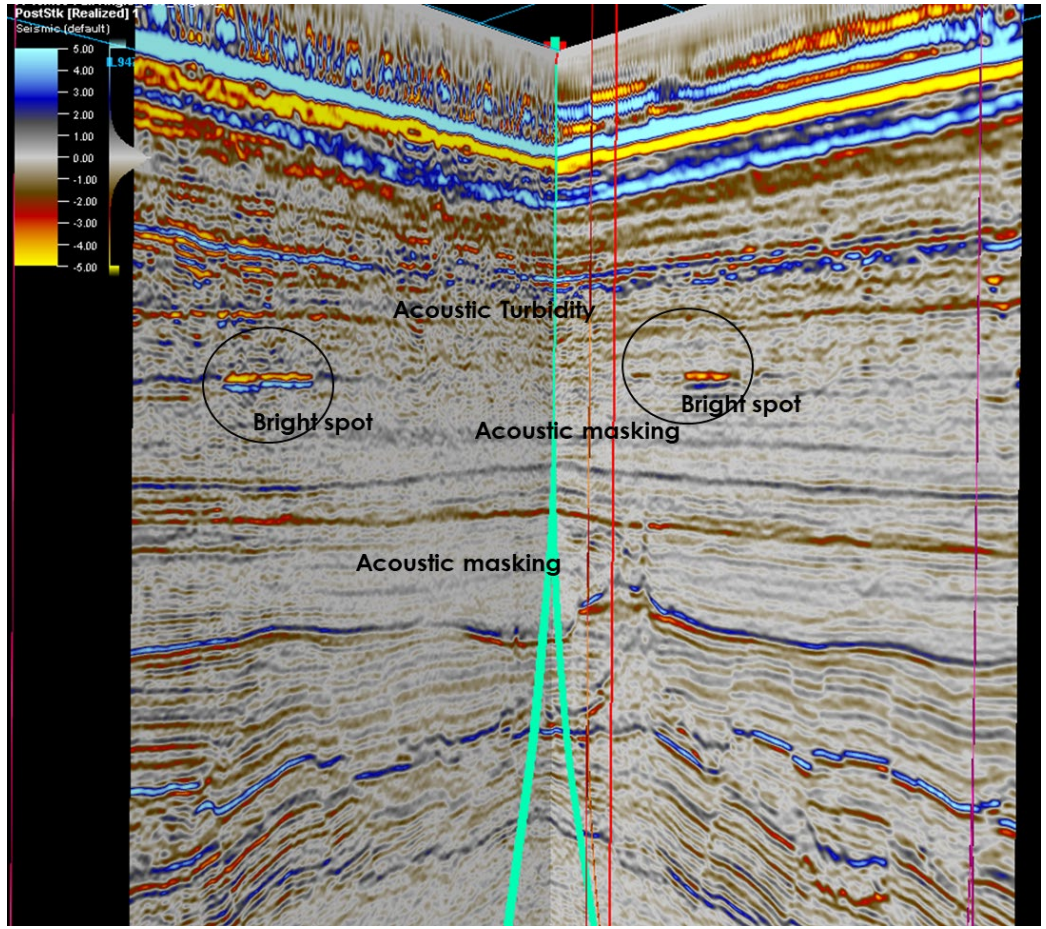
- Deghosting
- Designature
- Pre stack time migration (PSTM)

Are almost always removed from the site survey program to save costs = **misconception of the value**

2 - Bonus = Boulder Detection



3 – Integrate ALL Subsurface Data



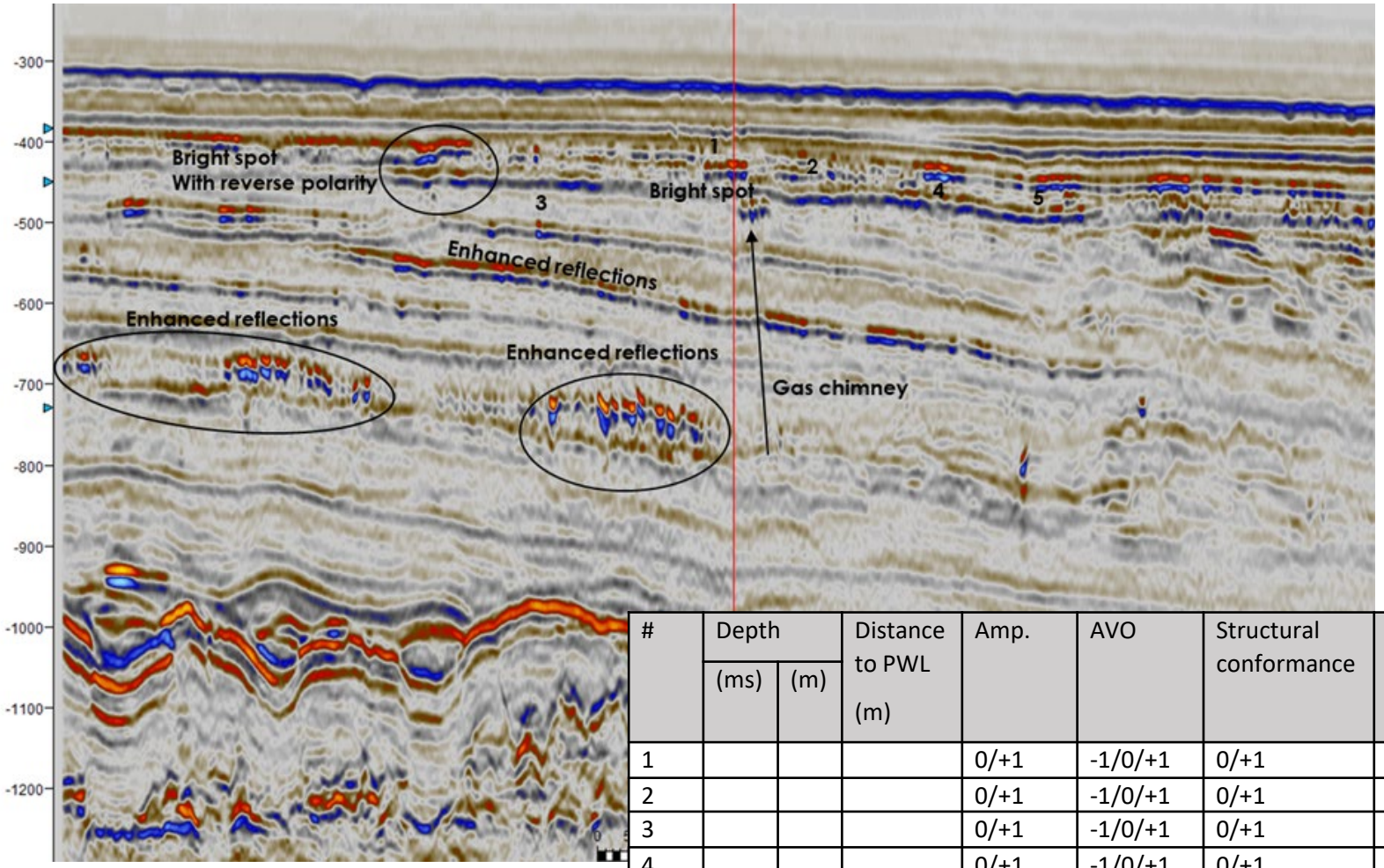
Integrated approach using:

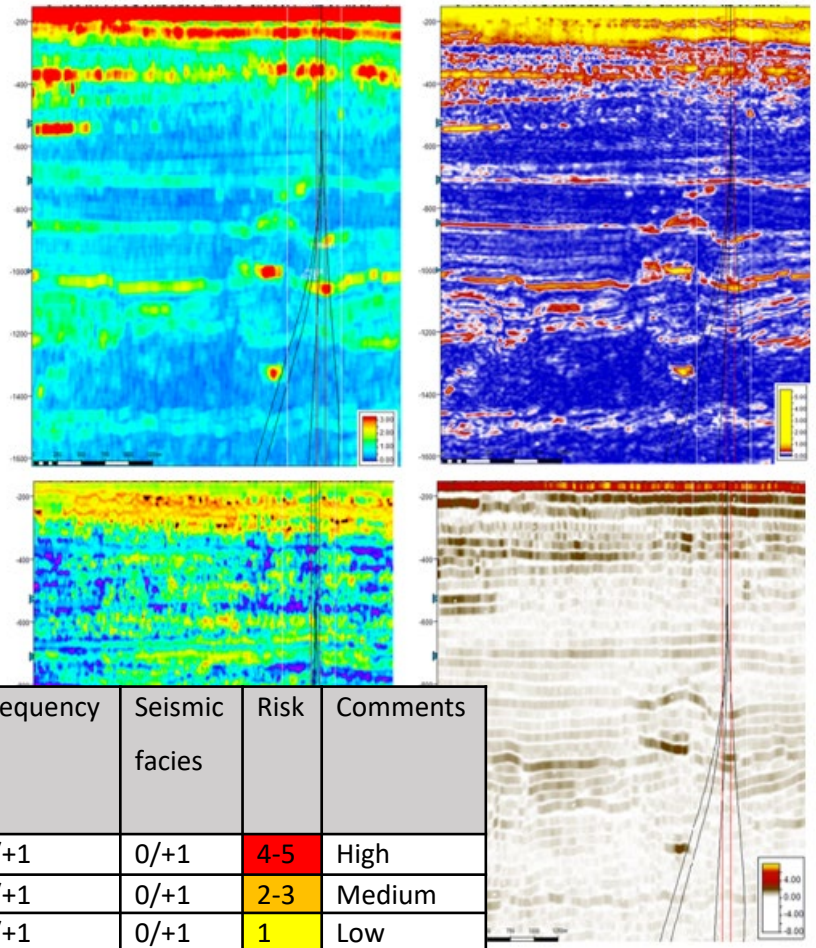
- Multiple datasets
  - 2DUHR & 3D, MBES, SBP
- Seismic attributes
- Velocity data
- Well data and experience

ALL DATA in DEPTH!

High Resolution Velocity data key to map & detect SWF

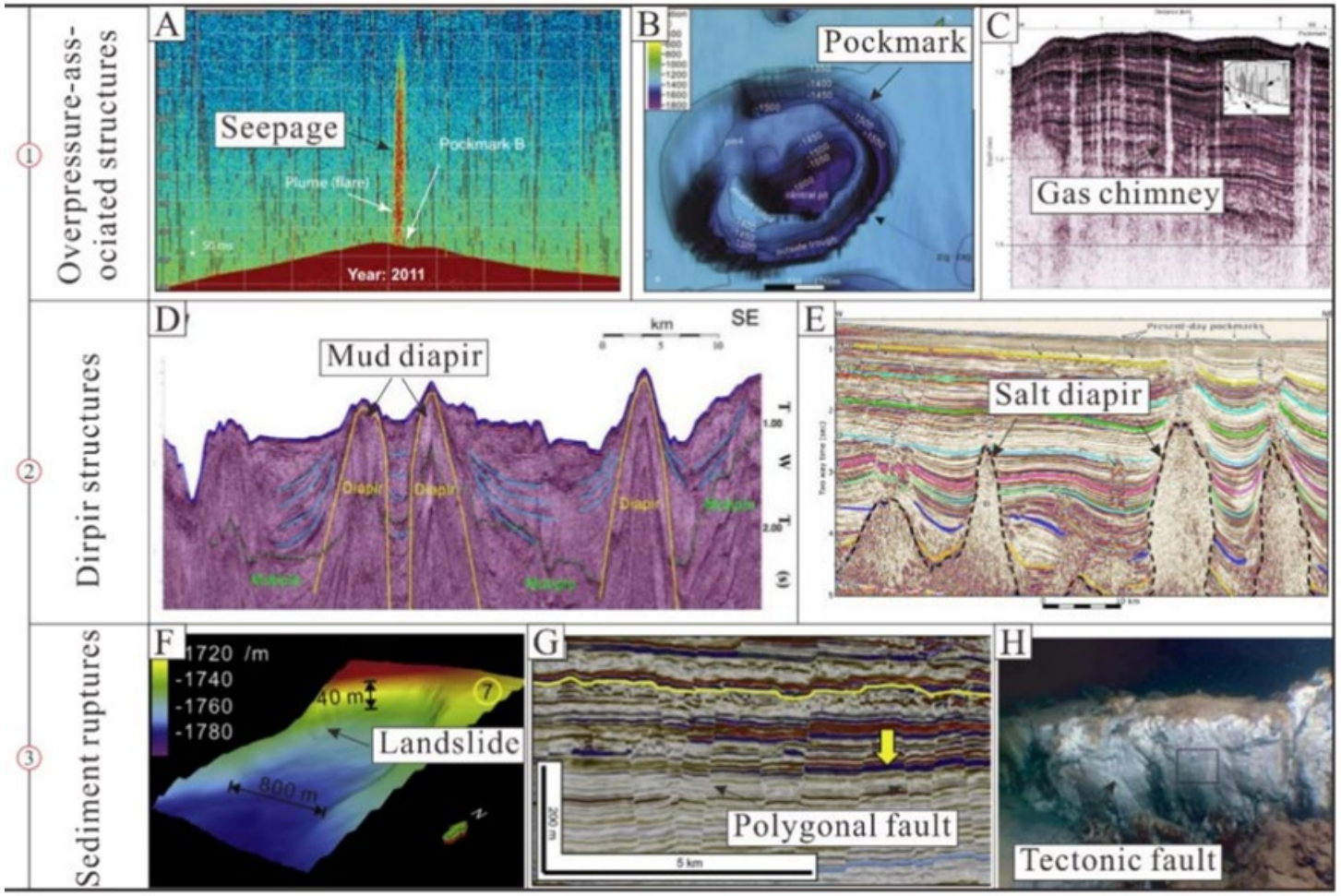
4 - Use Seismic Attributes & AVO





#	Depth		Distance to PWL	Amp.	AVO	Structural conformance	Frequency	Seismic facies	Risk	Comments
	(ms)	(m)	(m)							
1				0/+1	-1/0/+1	0/+1	0/+1	0/+1	4-5	High
2				0/+1	-1/0/+1	0/+1	0/+1	0/+1	2-3	Medium
3				0/+1	-1/0/+1	0/+1	0/+1	0/+1	1	Low
4				0/+1	-1/0/+1	0/+1	0/+1	0/+1	0	No Indicators

5 - Other Shallow Hazards



Example from Ma et al., 2021

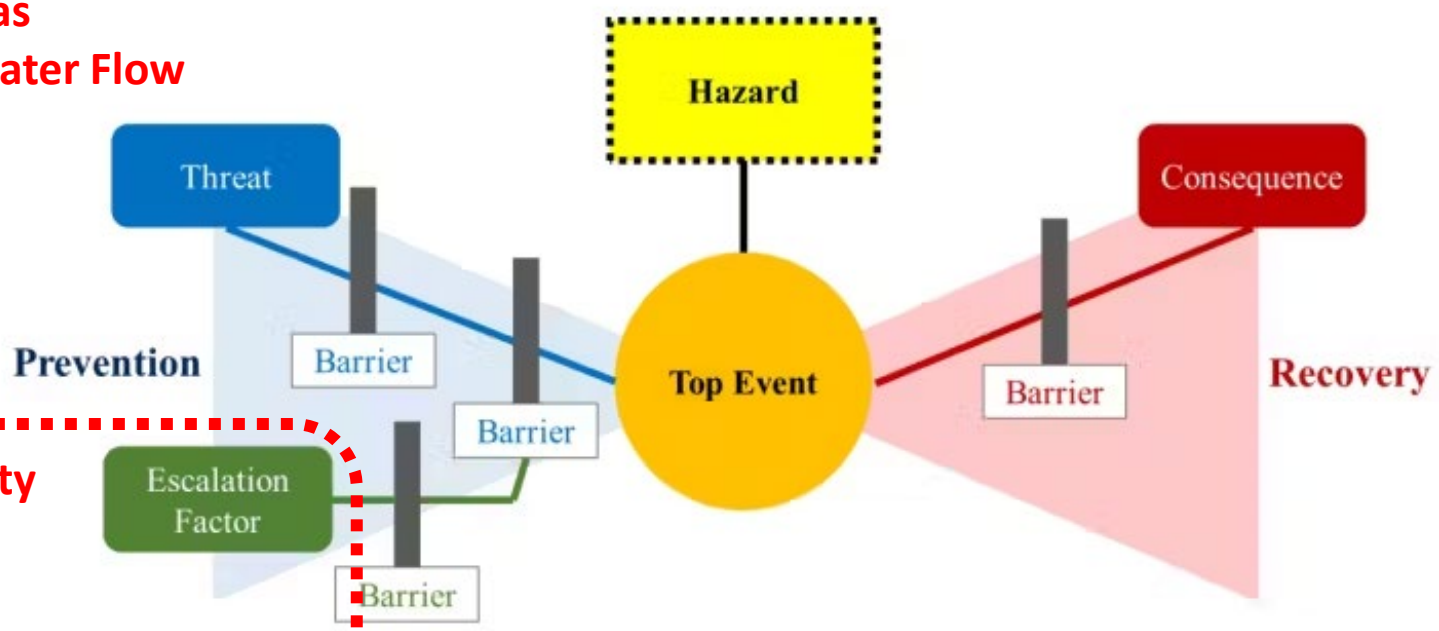
- Lots of different challenges across the Norwegian shelf incl. sand injectites & ooze
- Generally nothing that can't be handled

However ….

5 - Other Hazards = Potential Escalation

Shallow Gas
Shallow Water Flow

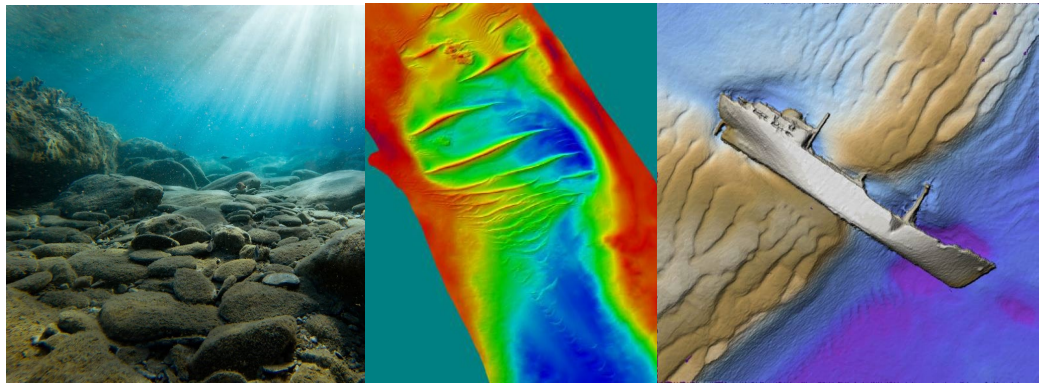
Gas Hydrates
Reduced strength
…



Wellbore Stability
Losses
Faults
Boulders
Time
…

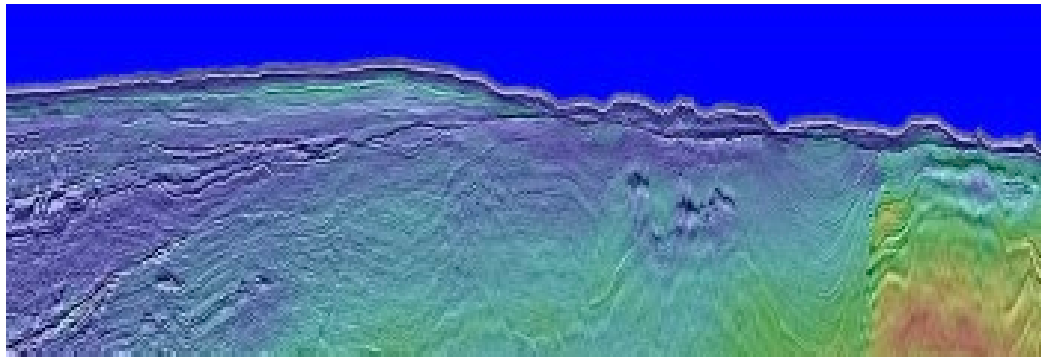
- Shallow Gas & SWF Escalation factors not assessed
  - e.g. Pilot Holes & swabbing
  - Interactions are not considered e.g. gas hydrates
- **Pilot hole or RMR ≠ barrier**

Need a hand?

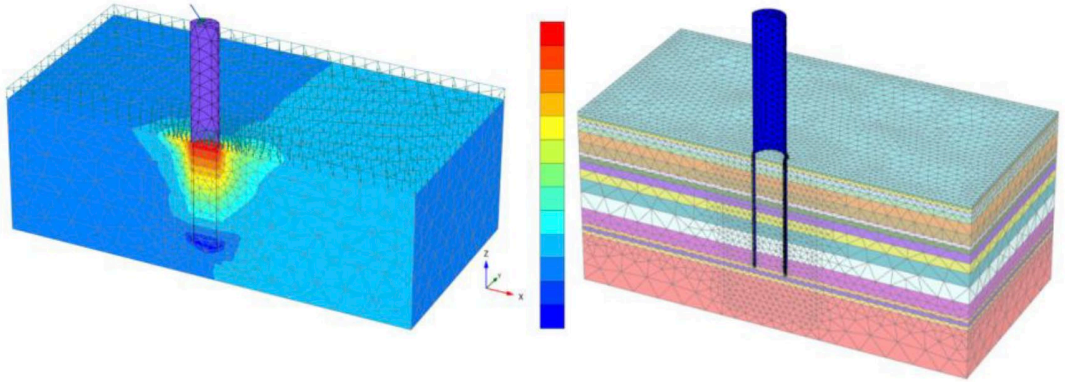


Site Characterisation & Route Studies

Survey Planning & Operations



High Res Processing & Interpretation



SSA Verification & Geotechnical Design