



ALCATEL
SUBMARINE
NETWORKS

Microseismic monitoring of storage sites

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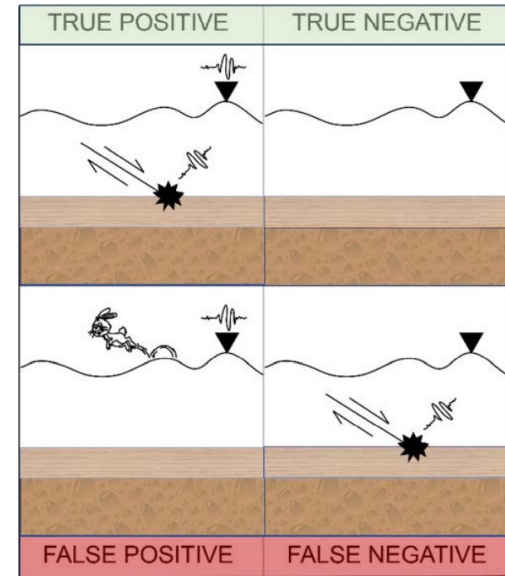
The Annual Bilateral Meeting 2023, Washington DC, USA
October 31, 2023



Main objective

Progression of microseismic monitoring technologies for seal integrity verification in CCS to become more

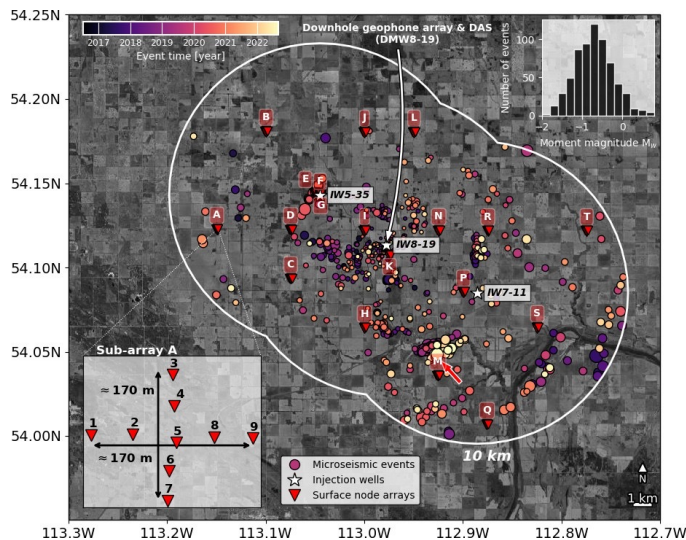
- robust
- cost-effective
- publicly accepted



Project highlights

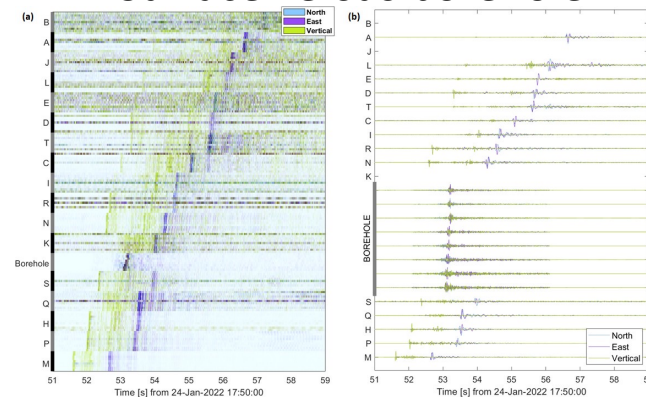
Combining and comparing various microseismic monitoring solutions (real data & modelling) highlight benefits and challenges of individual technologies for **detectability** and **locatability** of microseismic events.

Quest case study site

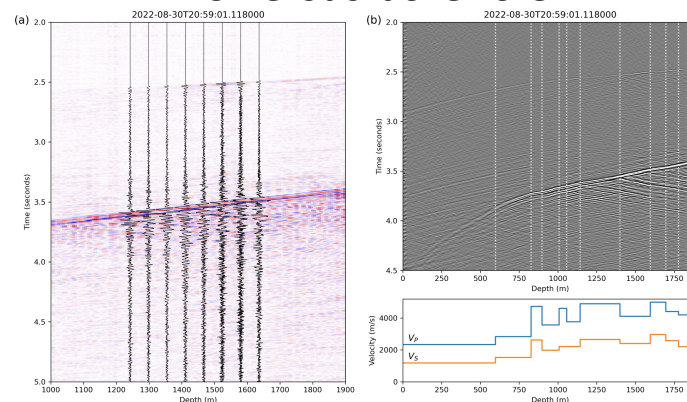


Goertz-Allmann et al.
(submitted to IJGGC)

Surface versus borehole



DAS versus borehole



Project highlights - detectability

Borehole:

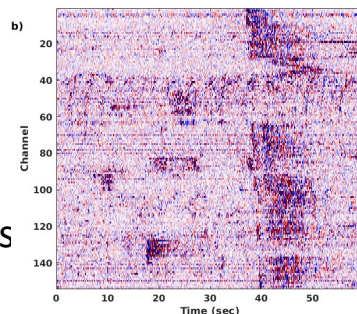
- High SNR: good detectability

→ Used as ground truth event catalog

With advanced processing we can improve detectability

Surface nodes:

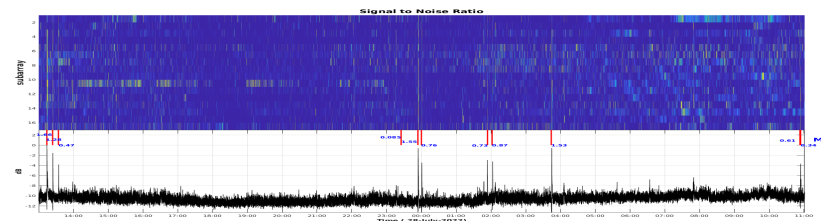
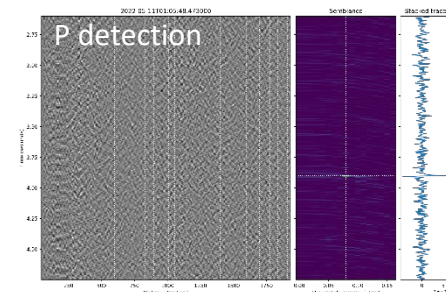
- Low SNR
- Attenuation
- Requires advanced pre-processing/filter techniques



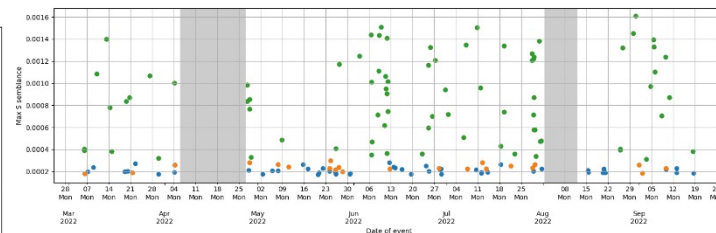
DAS:

- Higher instrument noise
- Weak P-wave
- Densely sampled along fiber → comprehensive picture of complex wavefield

semblance stacking to detect events



- Most events can be detected at surface
- But: high false detection rate



- About 50 % of events detected at DAS

DAS as viable source of high-quality monitoring data

Project highlights - locatability

Borehole:

- Poor azimuthal coverage → large uncertainties in event locations

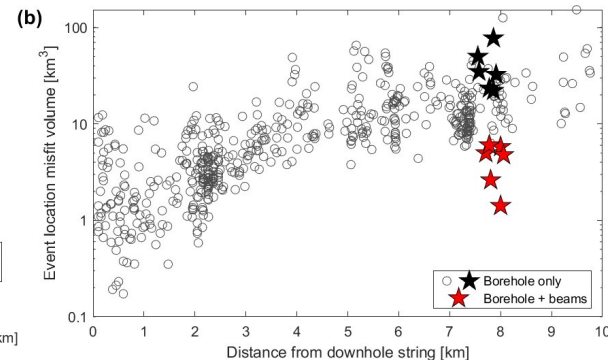
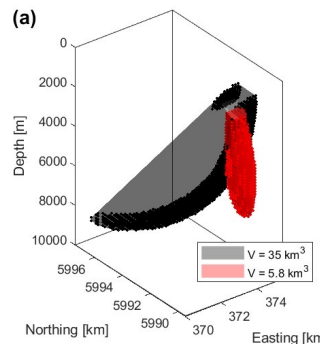
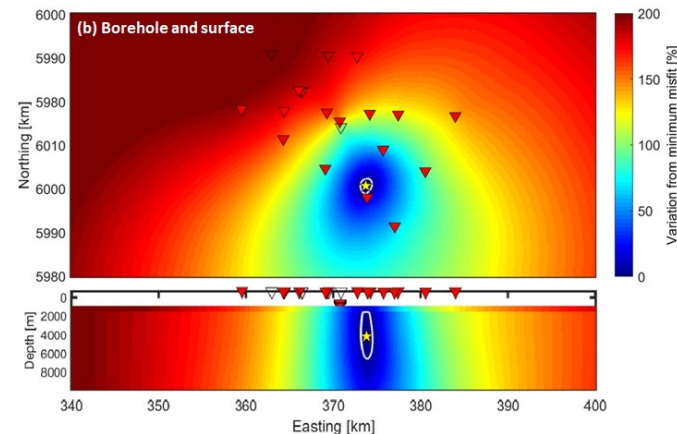
Surface nodes:

- Improved azimuthal coverage

DAS:

- Can only locate events with additional directional info from geophones but reduced event depth uncertainty

Reduced location uncertainty by combining data



Project highlights – Public perception

➤ Most comprehensive research effort on understanding public views of CCS to date.

Objectives

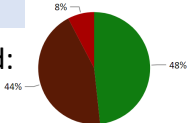
- 1) Can the public support or even accept CCS to reduce CO₂ emissions?
- 2) What factors matter to public acceptance & perceived fairness of CCS?

➤ Large public surveys & economic experiments in 5 countries (N > 5,000).

- No, I have not heard about it
- Yes, I have heard a little about it
- Yes, I have heard a lot about it

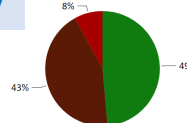
Canada

Not heard:
48 %



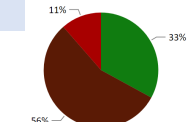
Germany

49 %



Norway

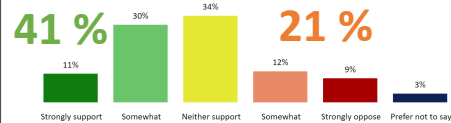
33 %



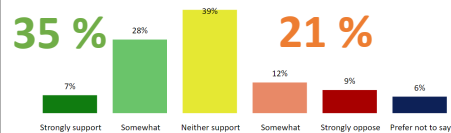
- Many have not heard about CCS.
- Majority supports CCS.
- Most rate risk of induced seismicity low but majority wants to mitigate its risk.
- More trust in environmental & independent organizations rather than industry & politicians
- All countries are critical towards importing CO₂.

Support for CCS

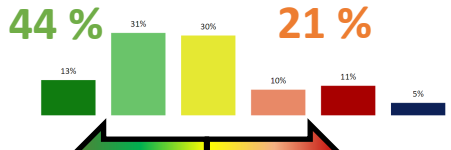
Canada



Germany



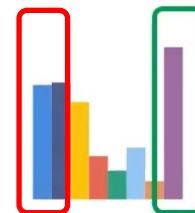
Norway



Strongly support

Strongly oppose

Norway



Overall safety of individual CCS projects

➤ Specialized independent oversight bodies

➤ CCS facility operators & governmental energy regulator

Expected impact



- Facilitation of storage verification by elevating the technology readiness level of microseismic monitoring.
- Verification of DAS-based microseismic monitoring as a viable option for CCS.
- Better understanding of driving factors for public acceptance of commercial applications.
- Learnings from ENSURE are already influencing monitoring plans at Quest and other newer CCUS projects.
- Tools for dimensioning of cost-effective monitoring networks at different sites.

Upcoming workshop on
“Public acceptance and
communication of CCS”

Date: 15. November 2023
Place: Amsterdam

Thank you for your attention!

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