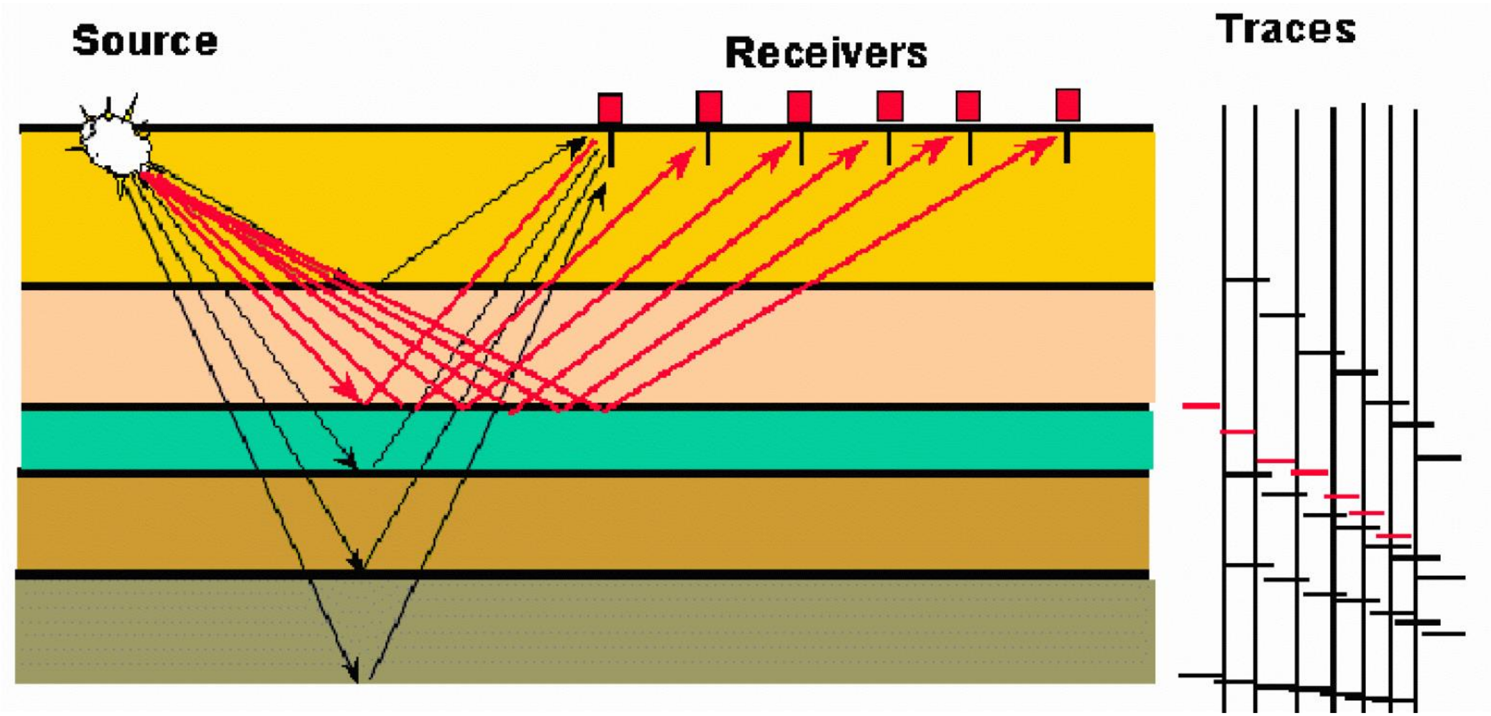
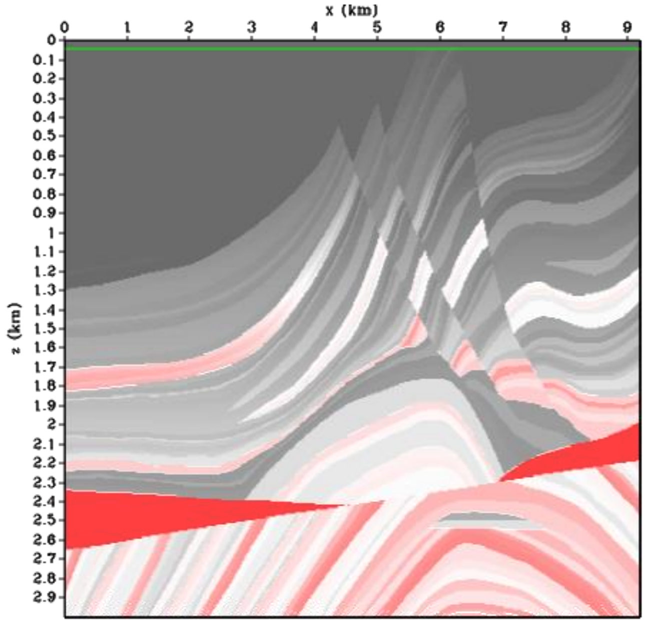
10. Reflection seismic

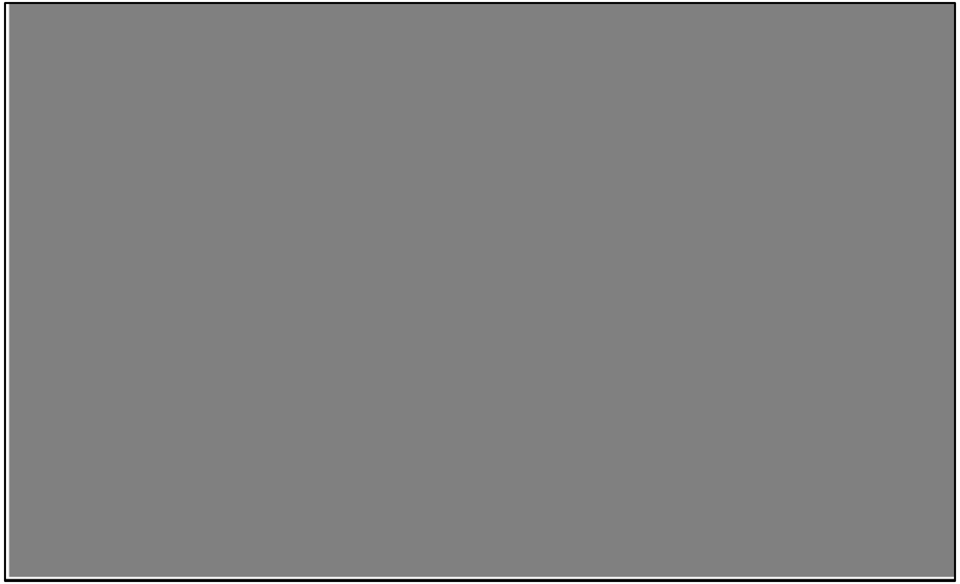
M. Ravasi | ERSE 210 Seismology

Seismic acquisition

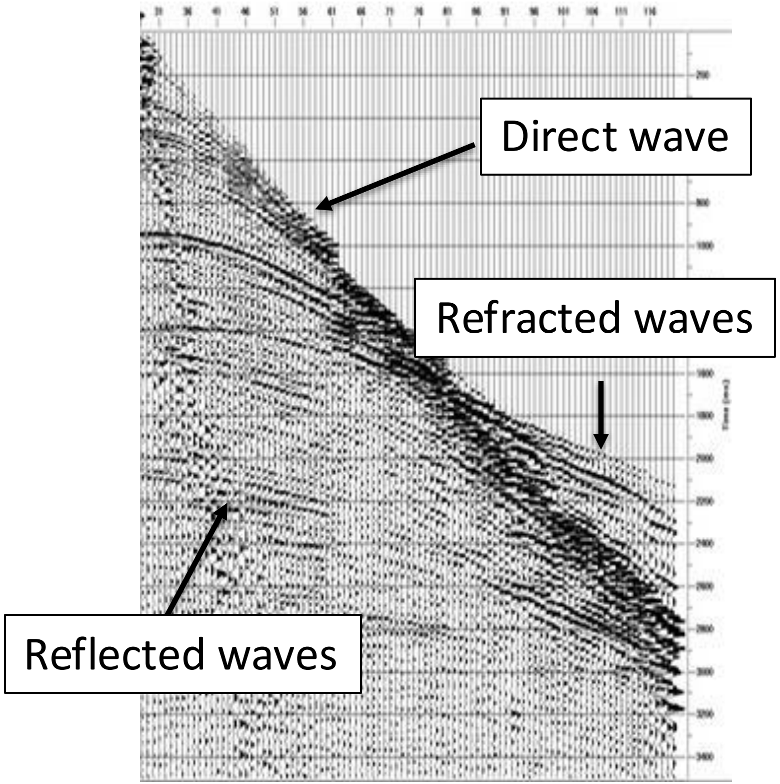


Seismic propagation movie

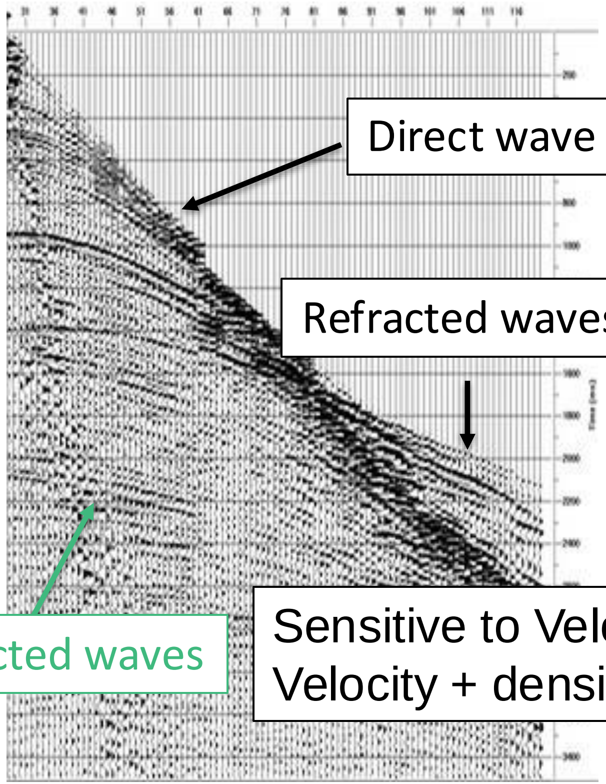




Seismic recordings

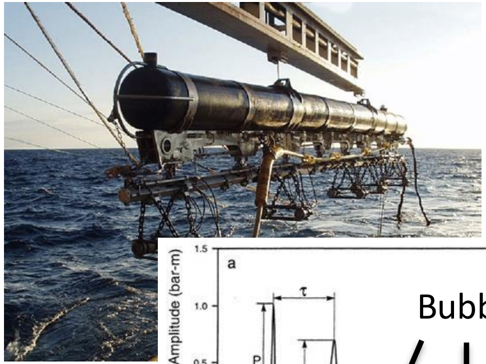


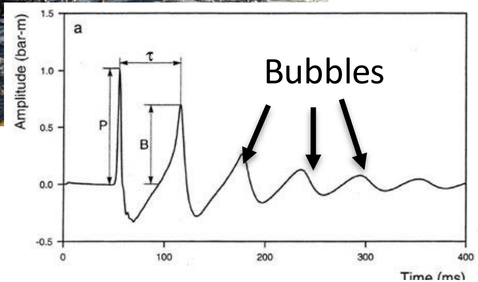
Seismic recordings



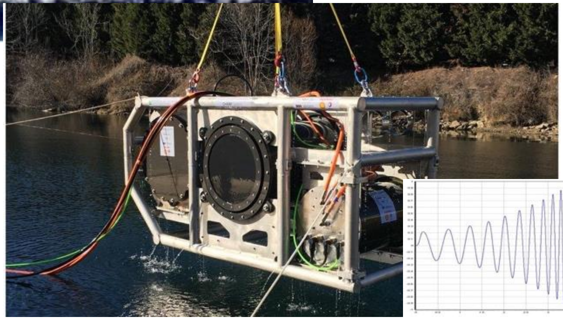
Seismic sources - marine

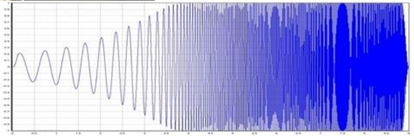
Airgun





Dynamite

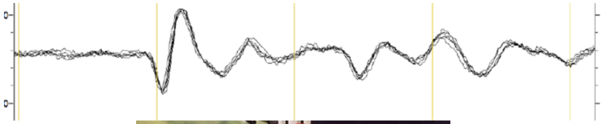




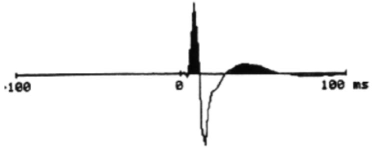
Sweep (chirp)

Marine Vibroseis

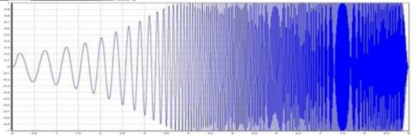
Seismic sources - land



Dynamite



Weightdrop

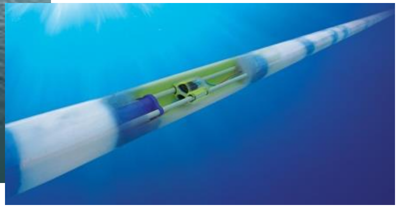


Sweep
(chirp)

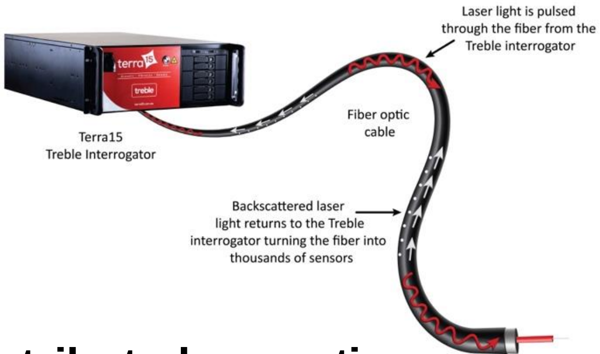
Vibroseis

Seismic receivers

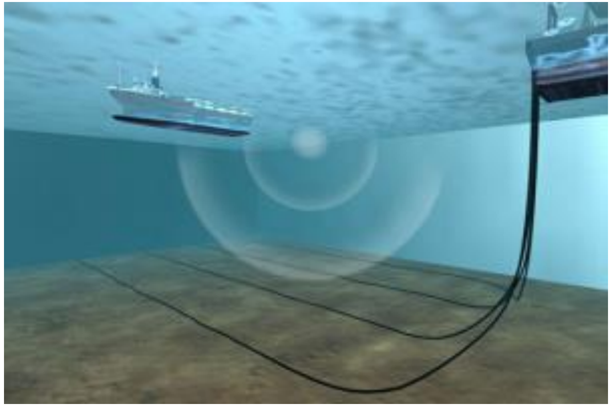
Streamer



Geophones



Distributed acoustic sensing (DAS)



Ocean bottom cables or nodes

Seismic receivers - land

Moving-coil Geophones (velocity)

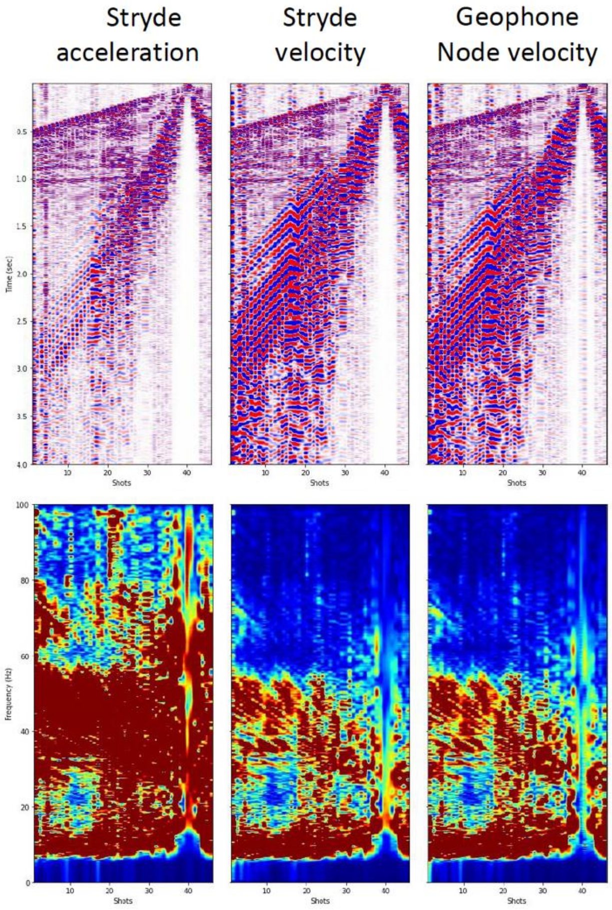
Piezoelectric (acceleration)

MEMS (acceleration)

Seismic receivers - land

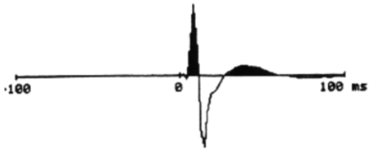
Geophones

Stryde node



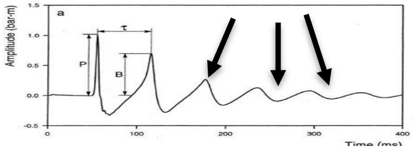
Seismic sources - signature

Dynamite



Easy to handle, almost ideal (spike)

Aiguns



One main peak followed by reverberations (bubbles), due to how energy is released. Several methods to estimate and remove bubbles and spike the main peak:

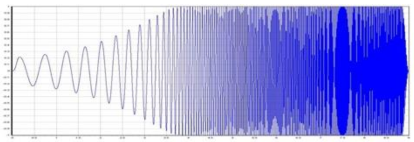
- Data-driven / statistical
- Near-field hydrophones
- Far-field signature modelling

} Estimate

Decon or shaping to remove: $d(t) = s(t) * r(t)$

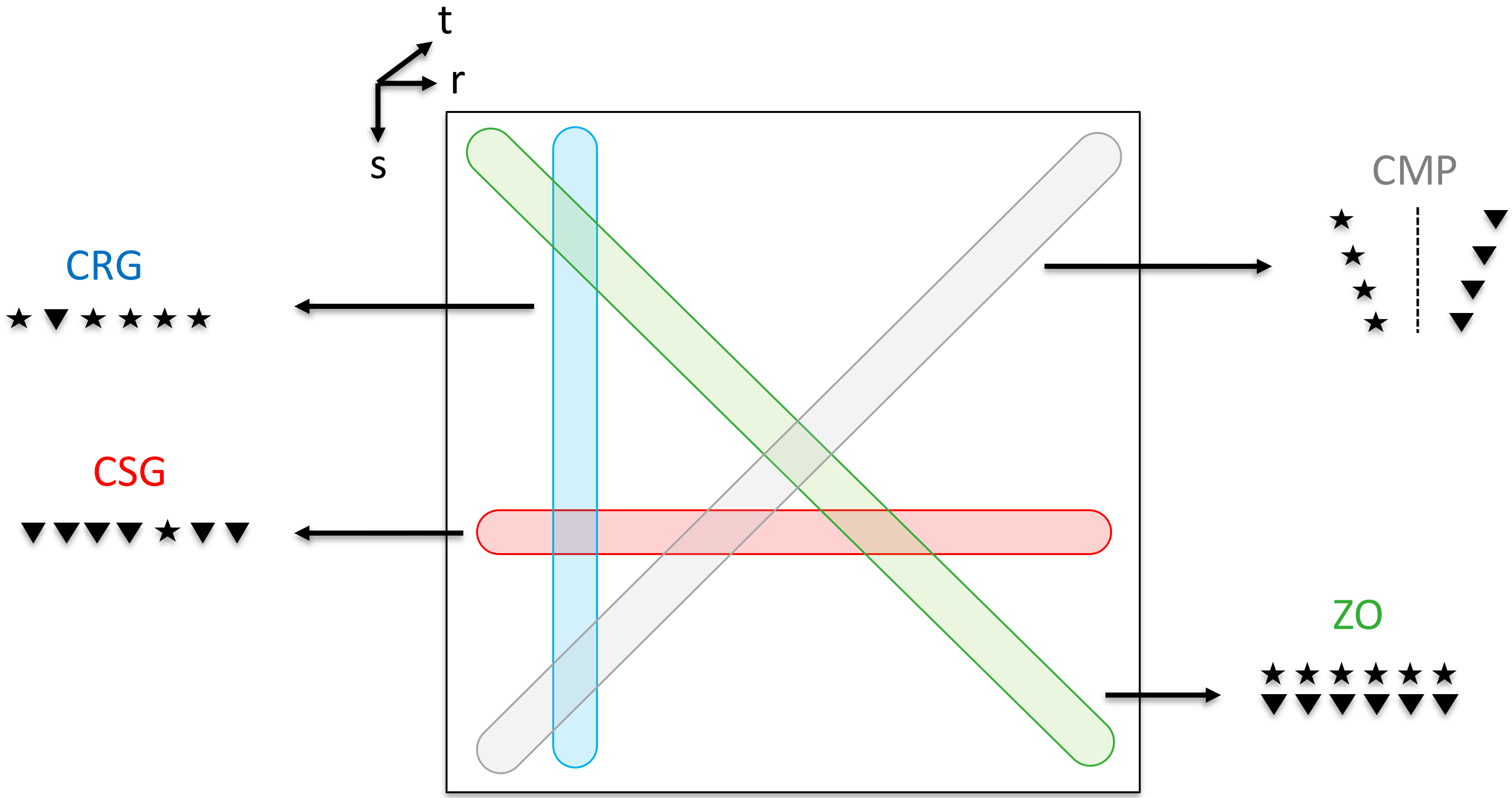
$$d_{shaped}(t) = F^{-1}\left(\frac{F\big(d(t)\big) \cdot S^{*}(\omega)}{|S(\omega)|\text{^}2}\right)$$

Vibroseis



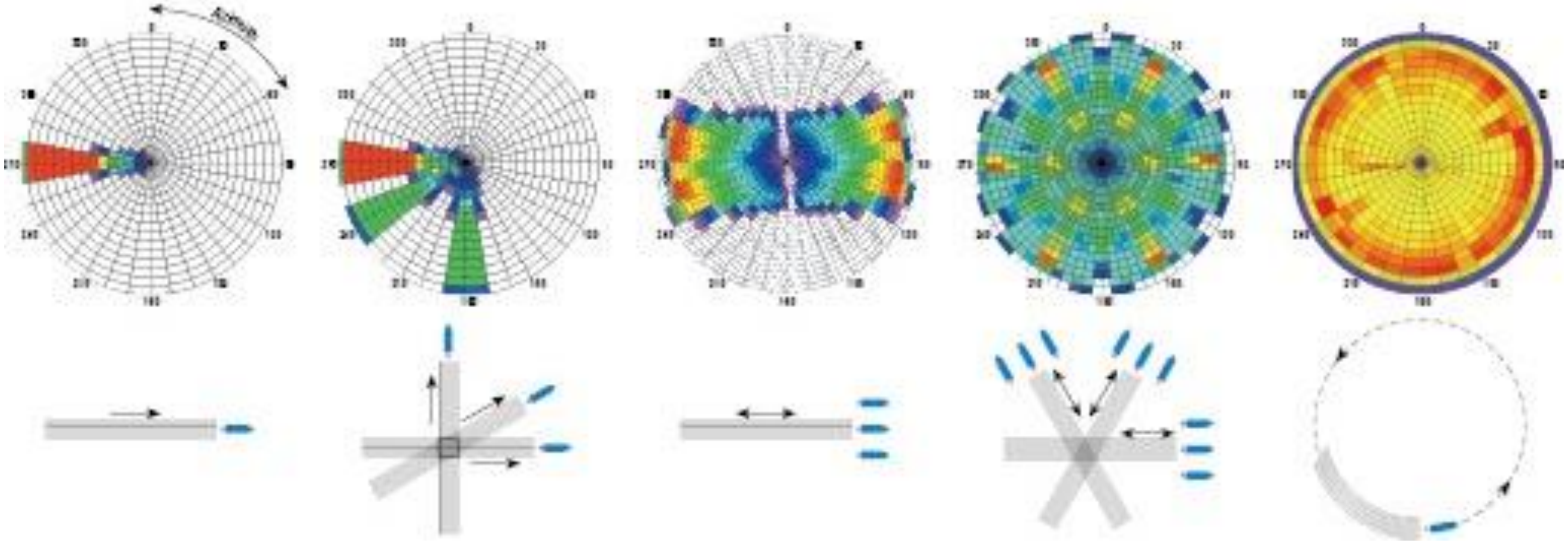
Correlation to turn chirp into spike: $d_{shaped}(t) = d(t) * s(-t) \approx r(t)$

Seismic Data Arrangements

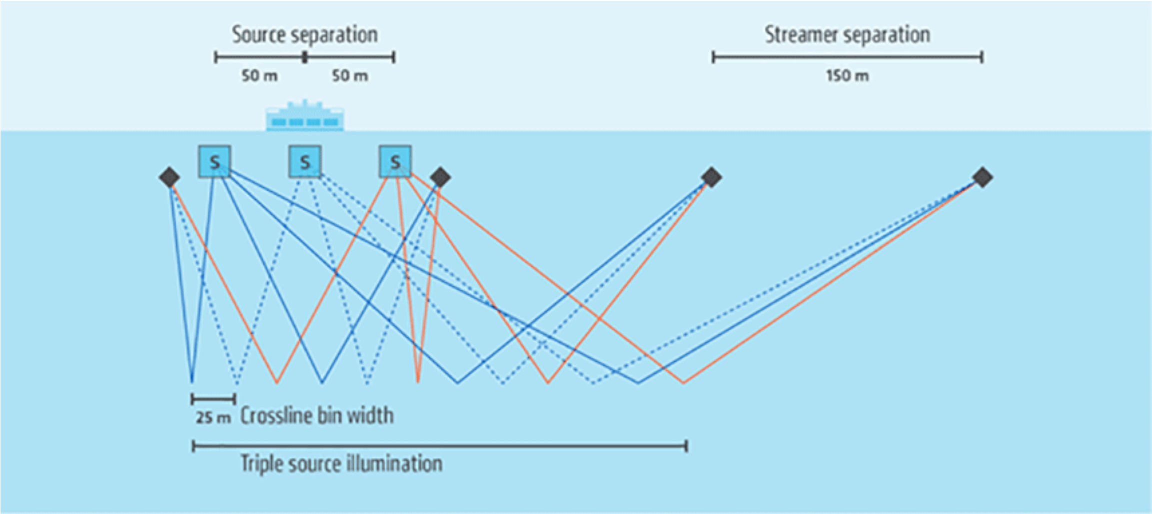


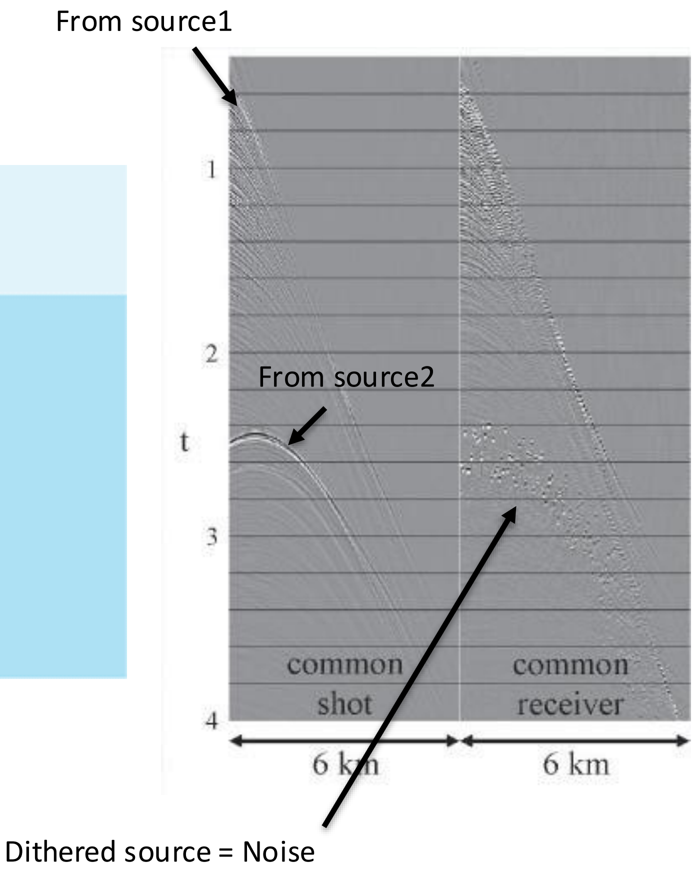
Seismic marine geometries

Narrow-Azimuth | **Multiazimuth** | **Wide-Azimuth** | **Rich-Azimuth** | **Coil Shooting**



Simultaneous shooting





$$J = \|\boldsymbol{\Gamma}^H \mathbf{b} - \mathbf{L}\mathbf{m}\|_p + \varepsilon \|\mathbf{m}\|_1$$

Seismic acquisition in KAUST

Seismic acquisition in KAUST

Seismic acquisition in KAUST

Survey ‘identification’: 2 teams of 3 people

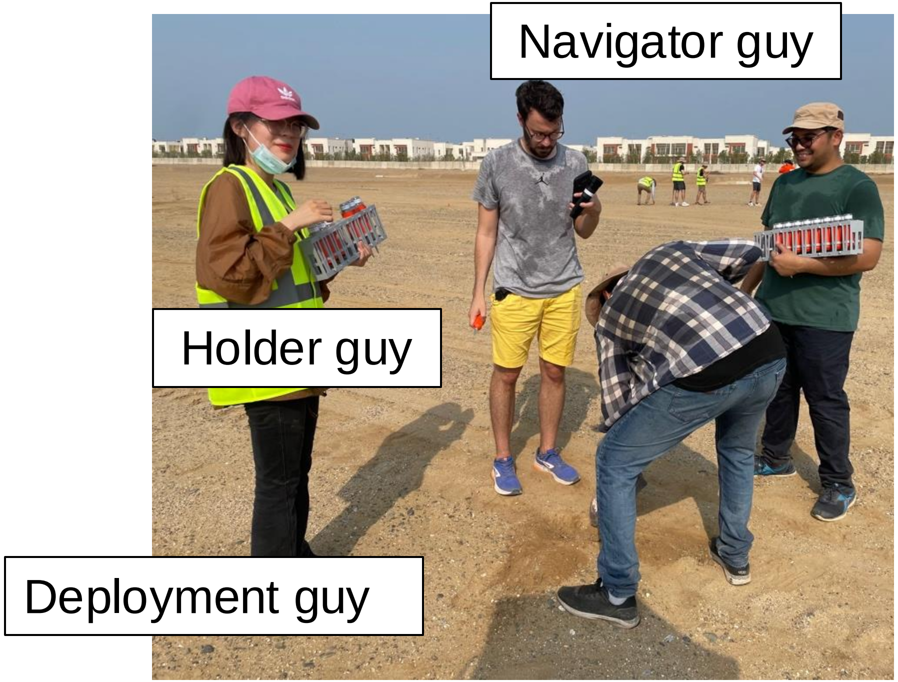
Tape guy

Digging guy

Stick guy

Seismic acquisition in KAUST

Sensor deployment: 2 teams of 3 people (will rotate…)



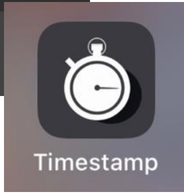
Seismic acquisition in KAUST

Shooting: 1 team of 3 people (will rotate…)

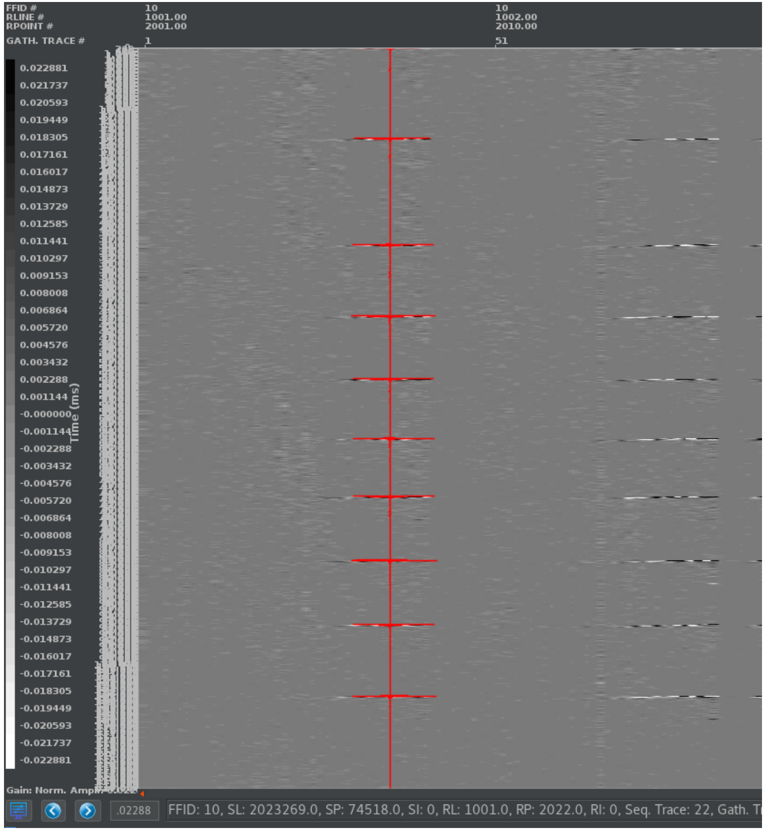
Counting guy

Shooting guy

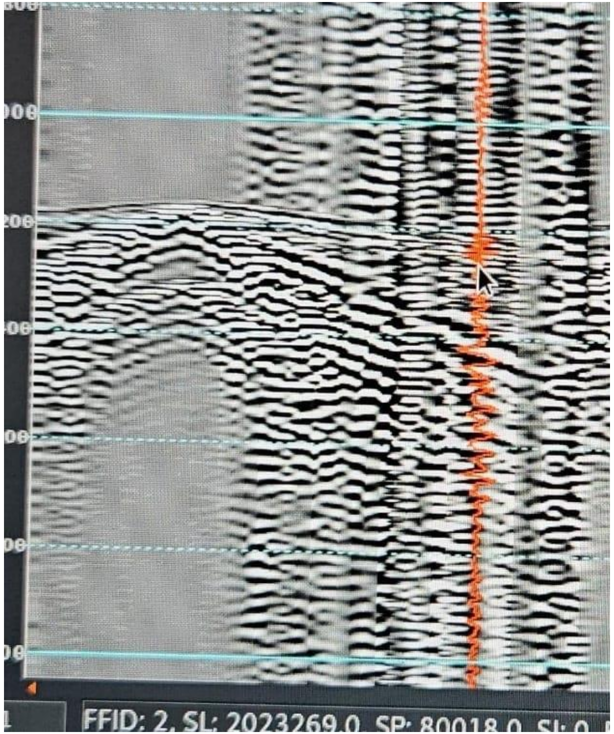
Timing guy



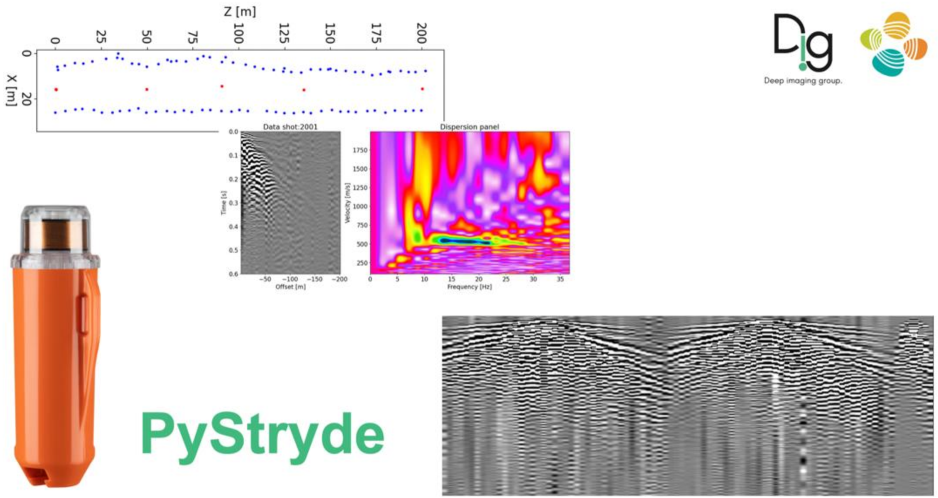
Seismic processing in KAUST



Create shot records



Seismic processing in KAUST

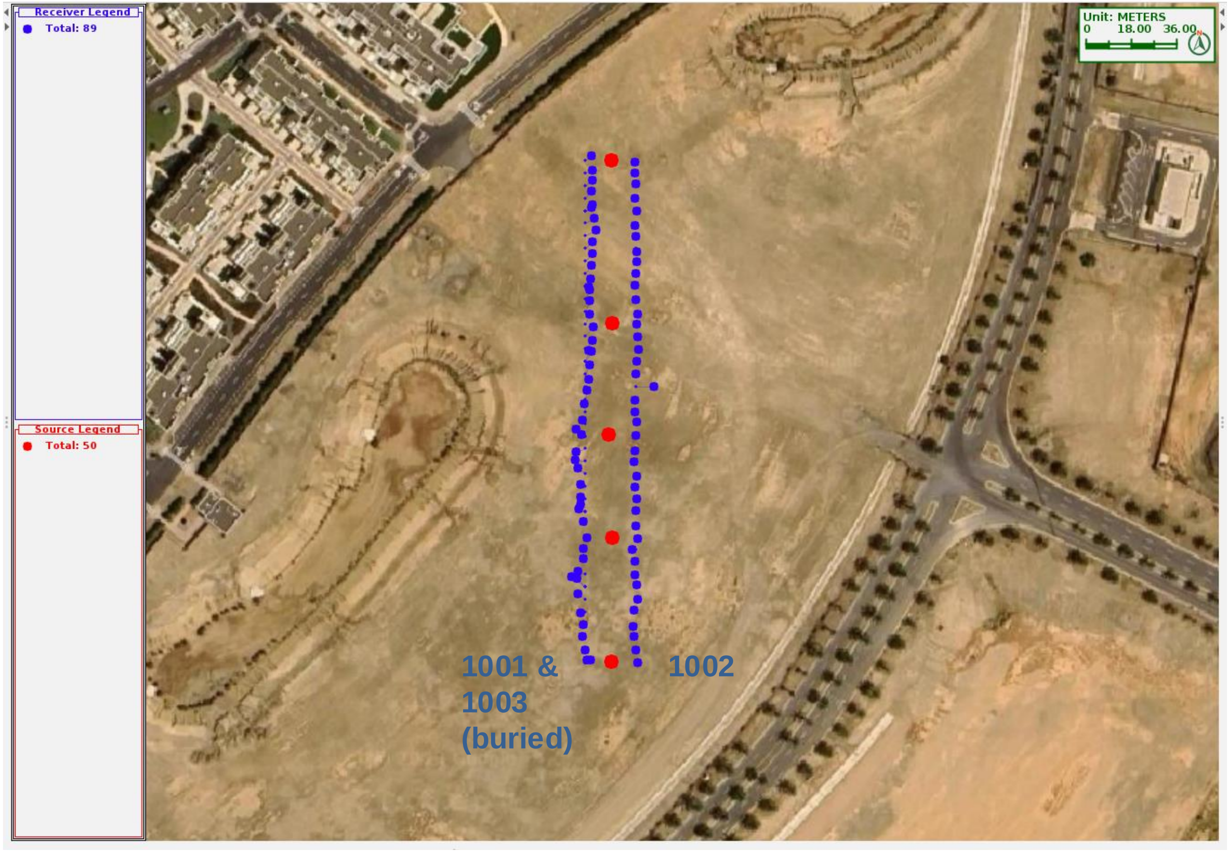


This repository contains all the routines that our group has created to manipulate and visualize SEG-Y data produced by STRYDE SeismicQC software.

Moreover, all the notebooks created to perform basic analysis of the data acquired over time are also available for others to get started with the associated data.

https://github.com/DIG-Kaust/StrydeProjects

A sneak peek from our first experiment



Receivers:

2 lines of 41 planted receivers each, equally spaced by 5m for a total lenght of 200m (lines separated by 20m).

1 line of 7 burid receivers spaced 30m apart

Shots:

5 Shots placed in between 2 lines at Point 2041, 2028, 2019, 2011, 2001 in order of shooting.

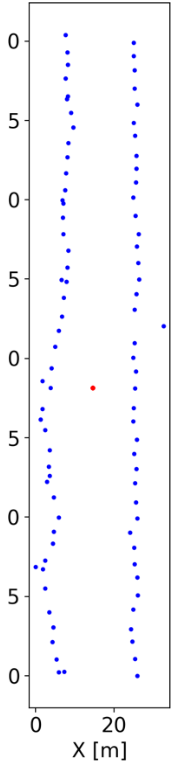
10 shots per source starting at time:

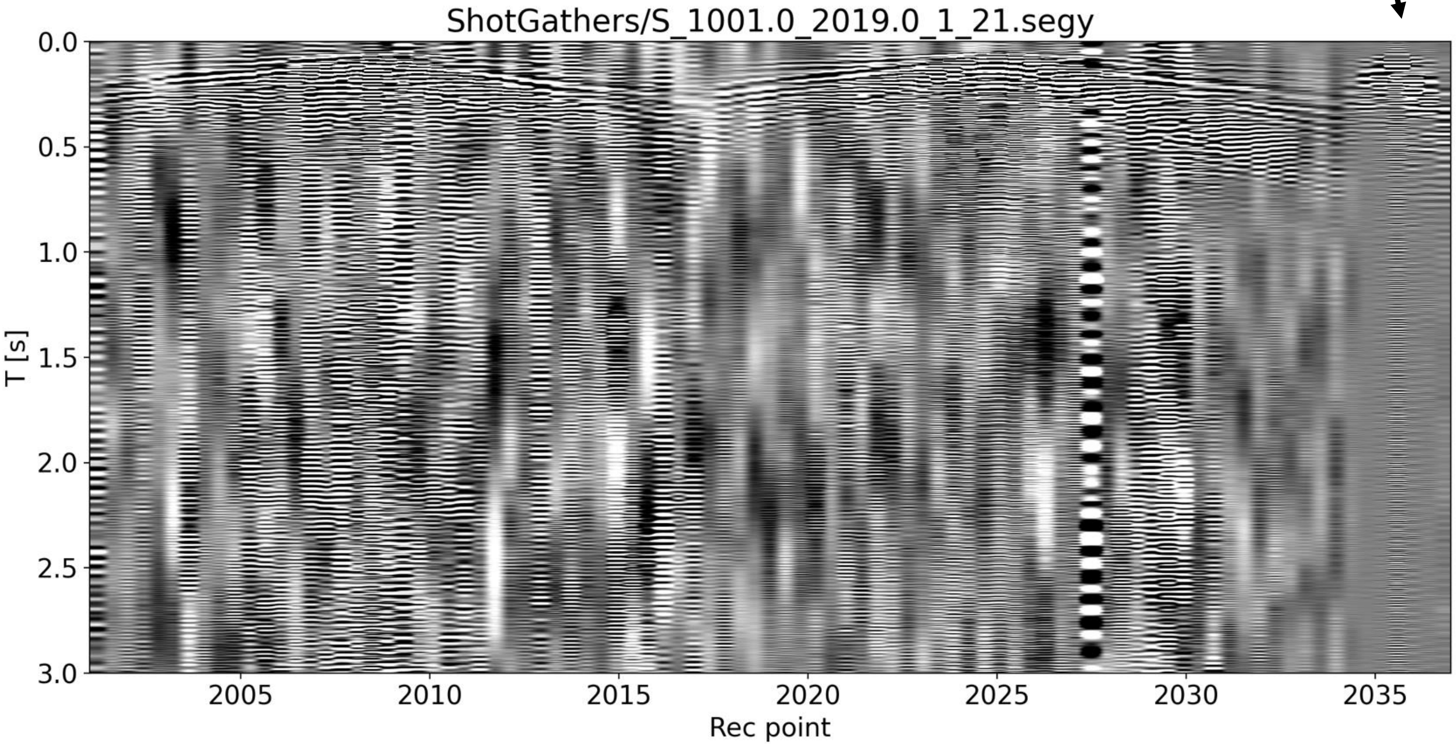
2041: 10:45
2028: 10:51
2019: 10:56
2011: 11:00
2001: 11:06

Raw shot gather

Buried! Let's bury…

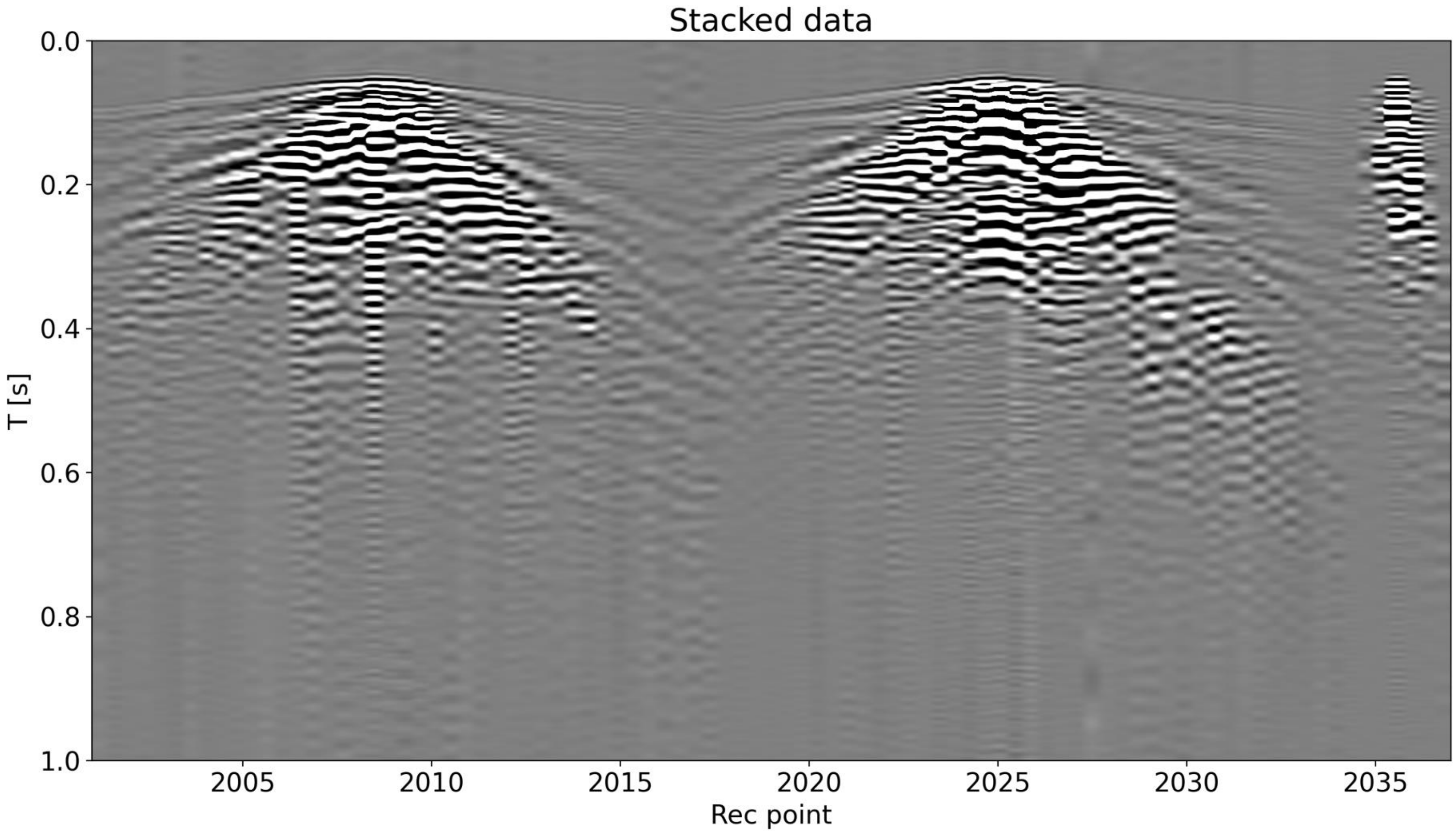
Local geometry



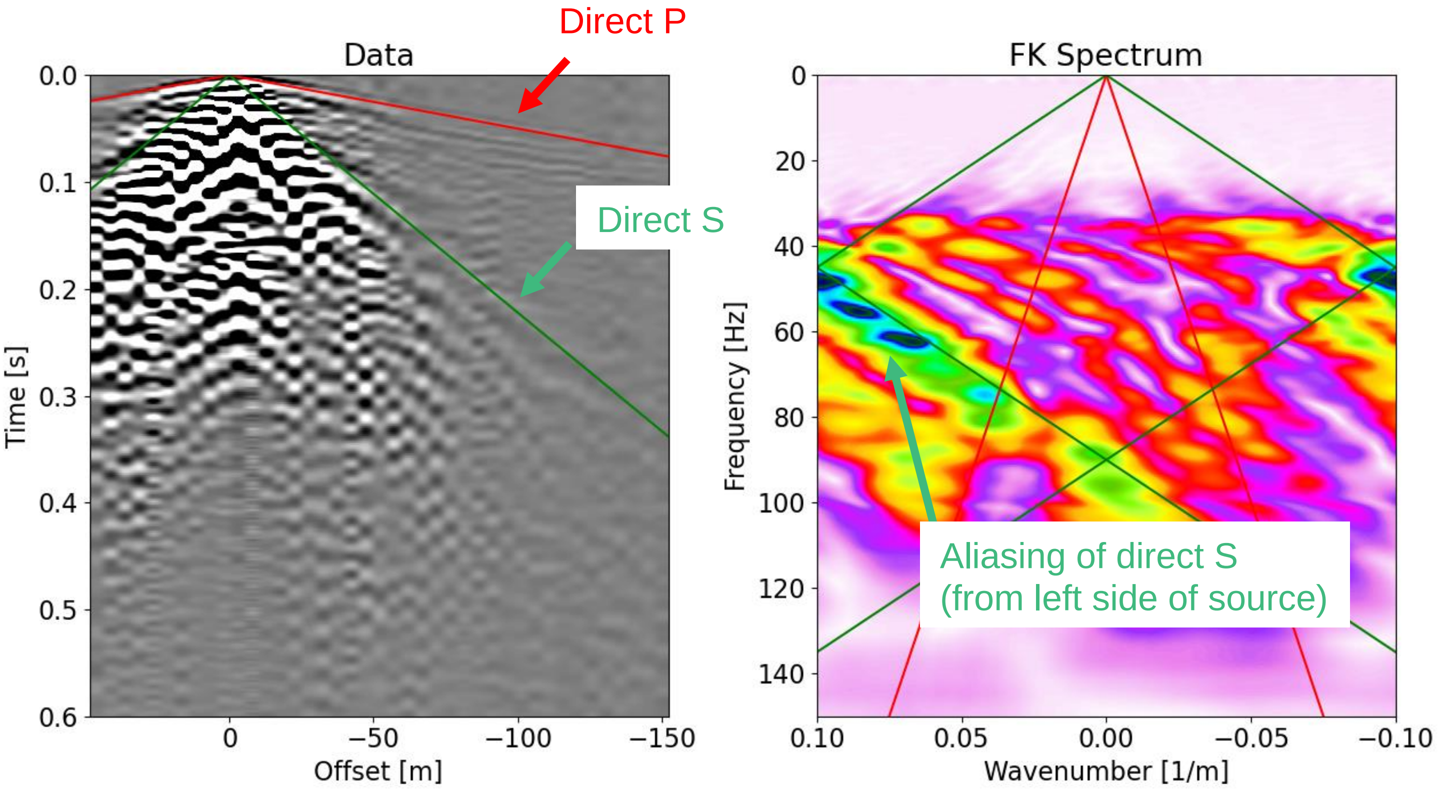


<u>All analysis is done here on shot 2019</u>

Stacked shot gather



Data analysis



Use shot at 2011 as aliasing is more visible (easier to explain