

Short range geoacoustic inversion with a vertical line array

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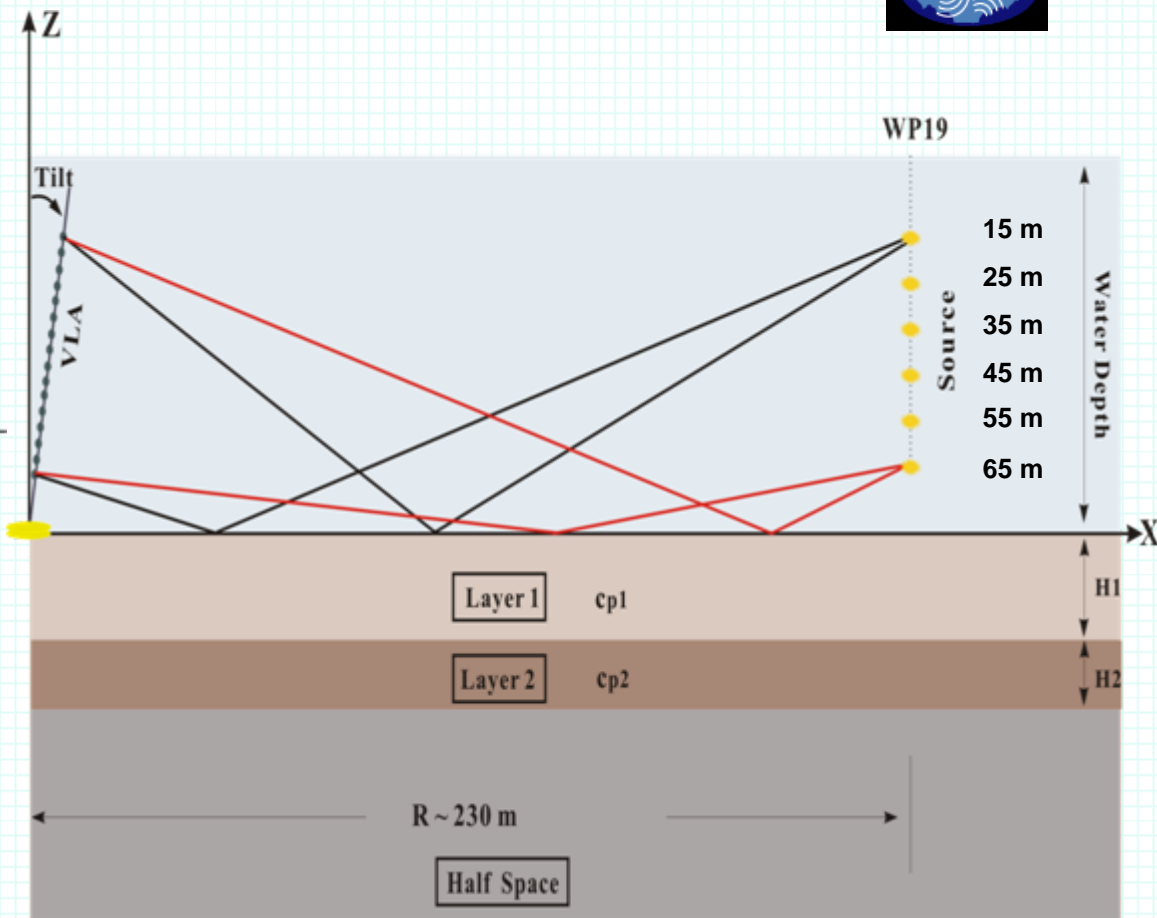
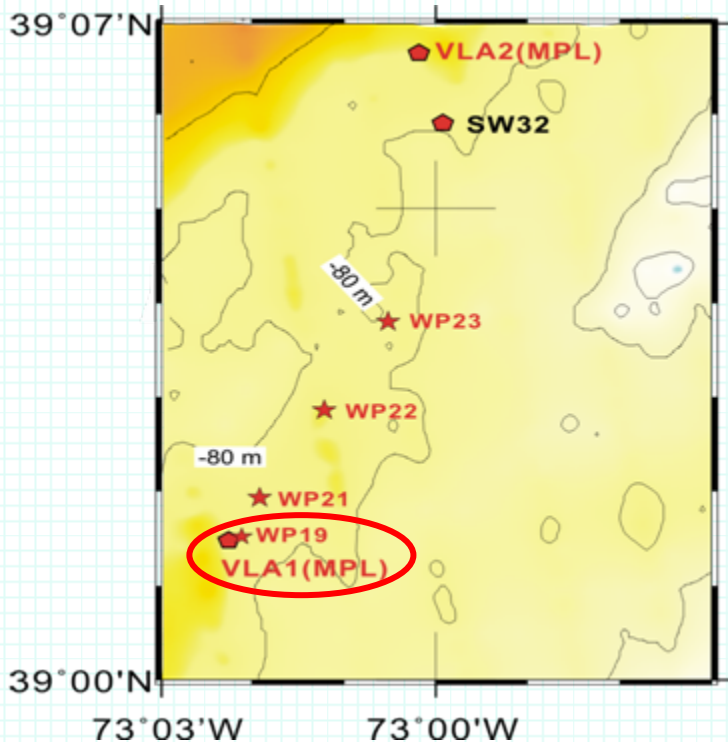
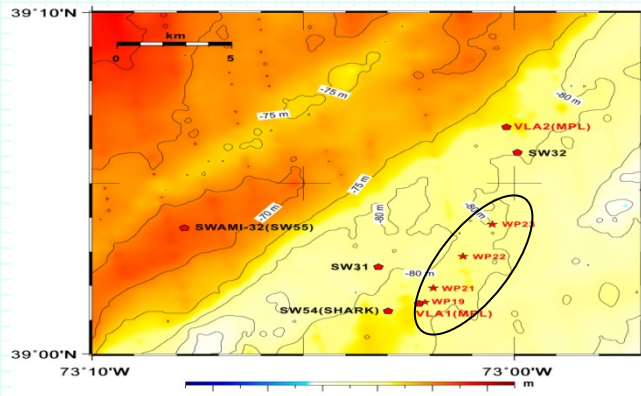
Objective:

Travel time geoacoustic inversion in a time varying ocean environment using broadband signal and vertical line array

Outline:

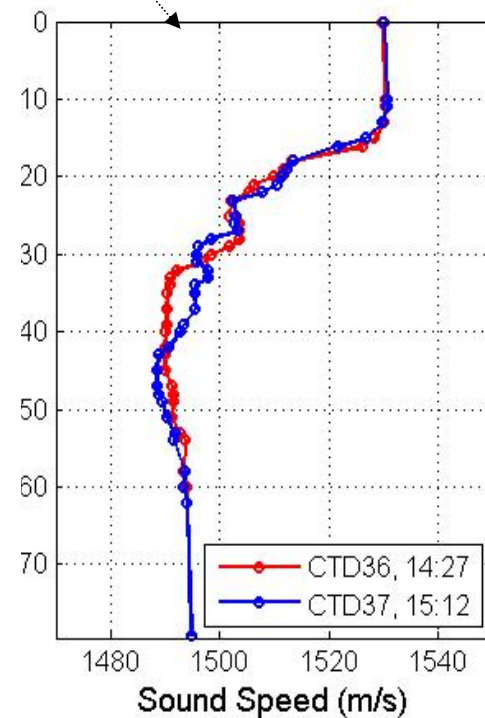
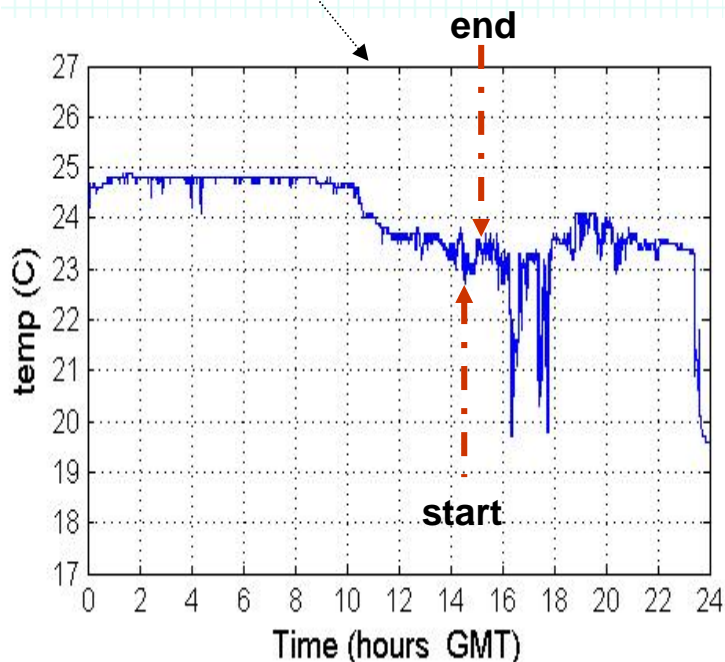
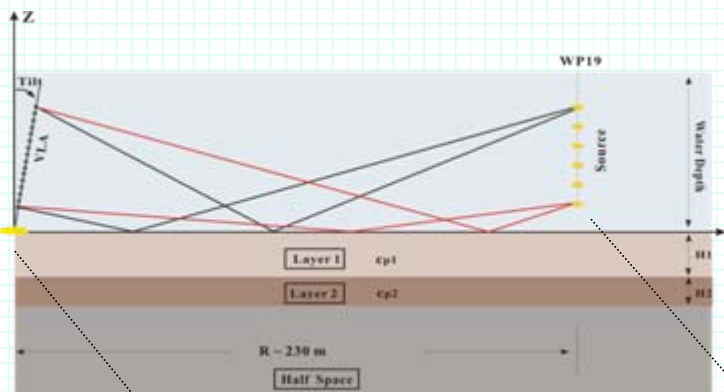
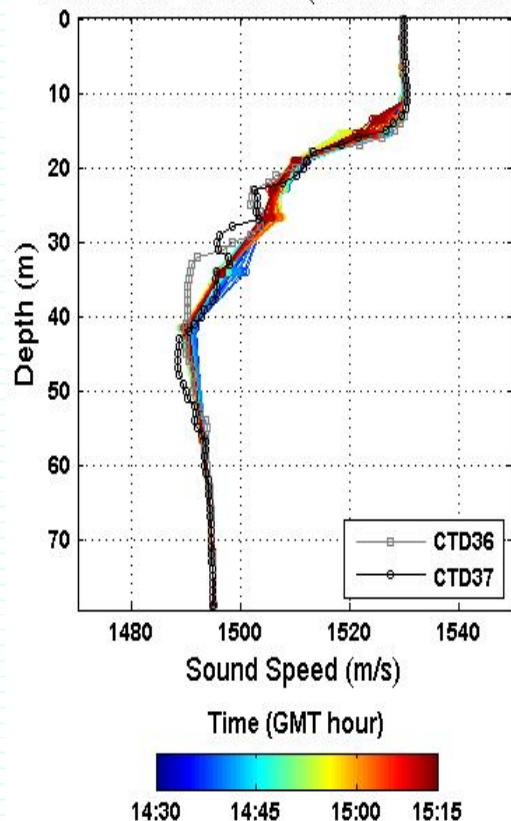
- Experimental site & geometric setting up
- The time varying environment
- The inversion procedure
- Energy function, forward model and inversion algorithm
- Comparison of the inversion results with geophysical survey
- Conclusions

Experimental site & set up

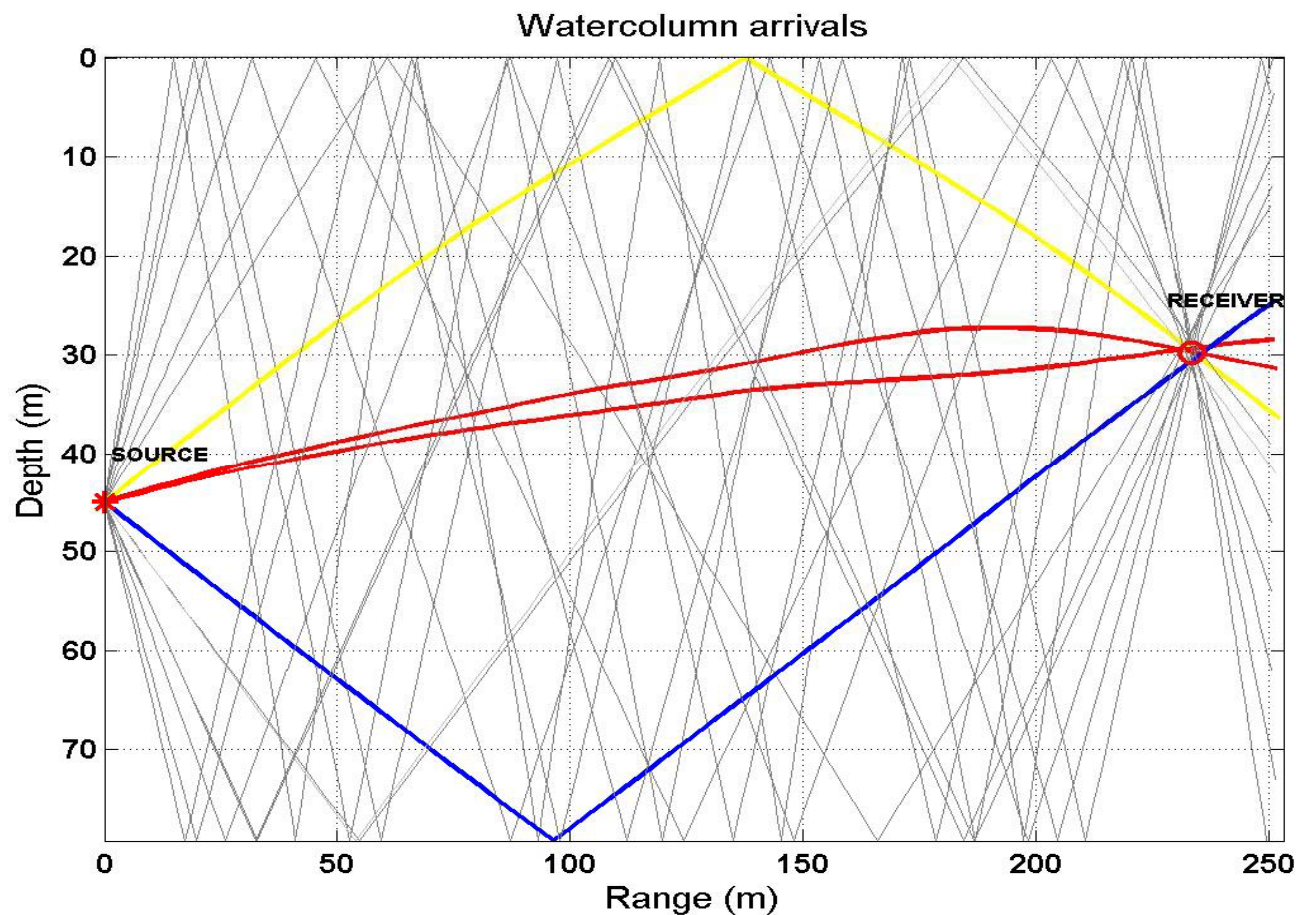


The time varying oceanic SSP

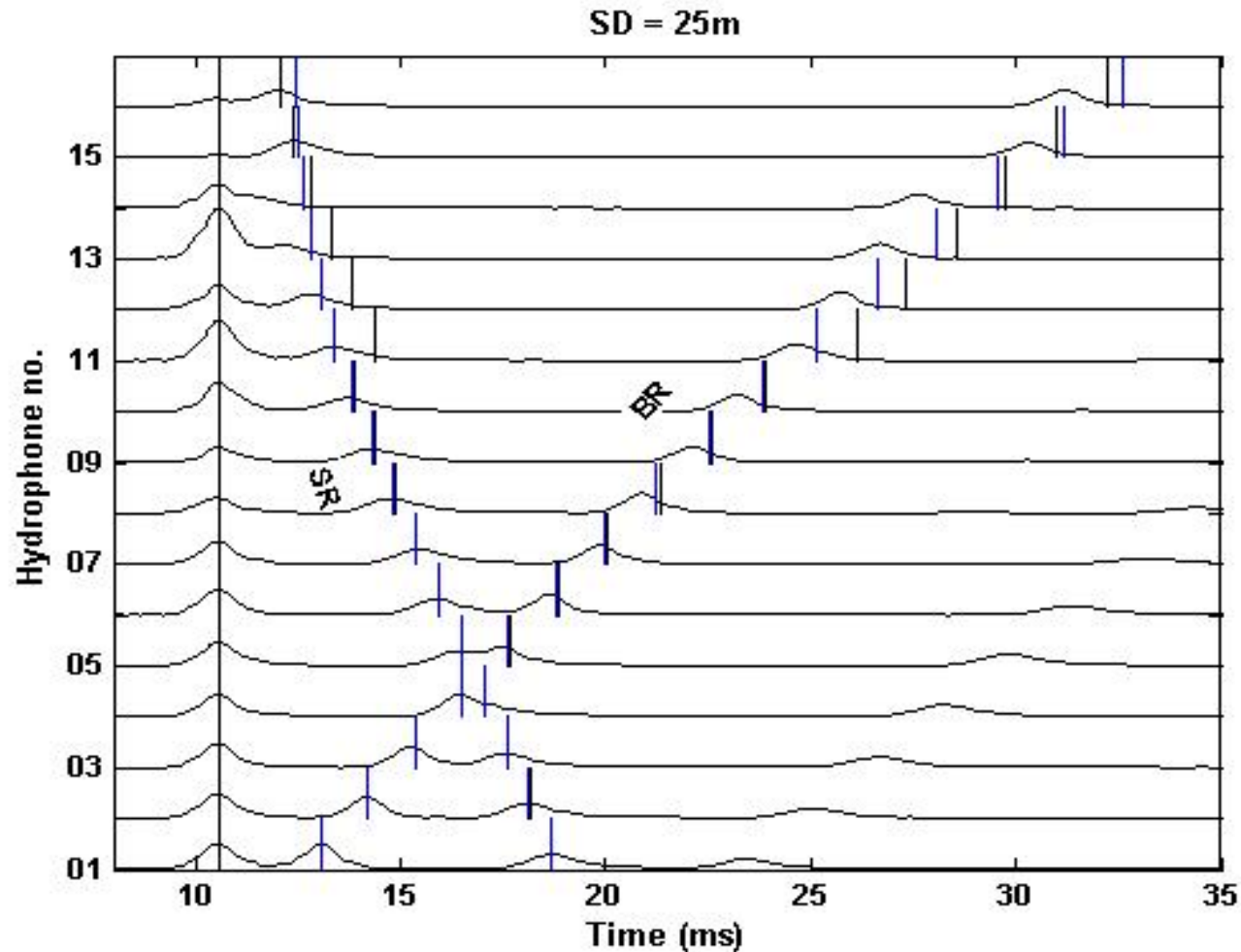
SHARK SSP for JD243 (14:30 to 15:12 GMT)



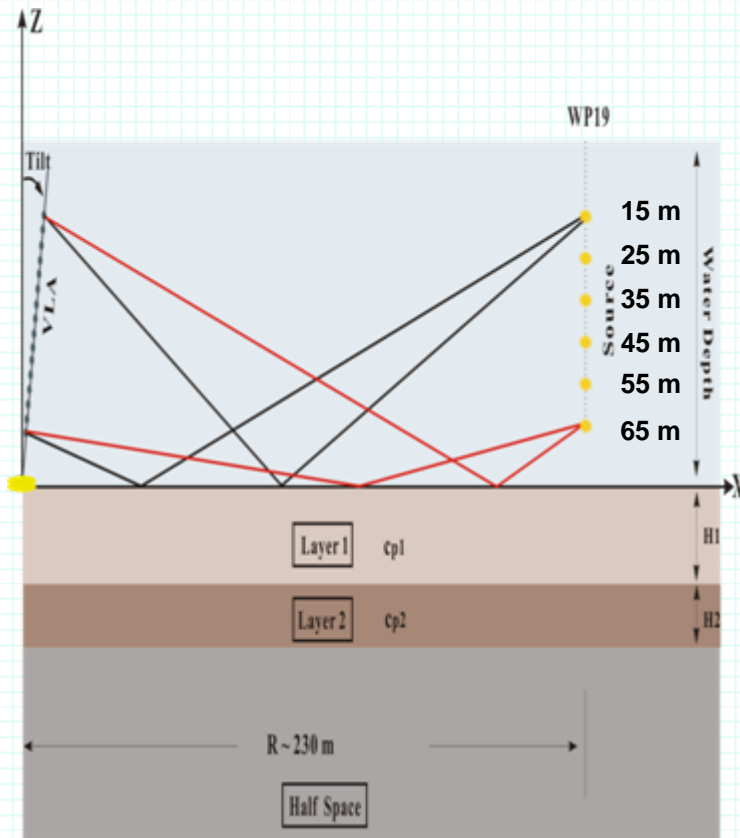
The effect of SSP on signal amplitude



The effect of SSP on arrival time

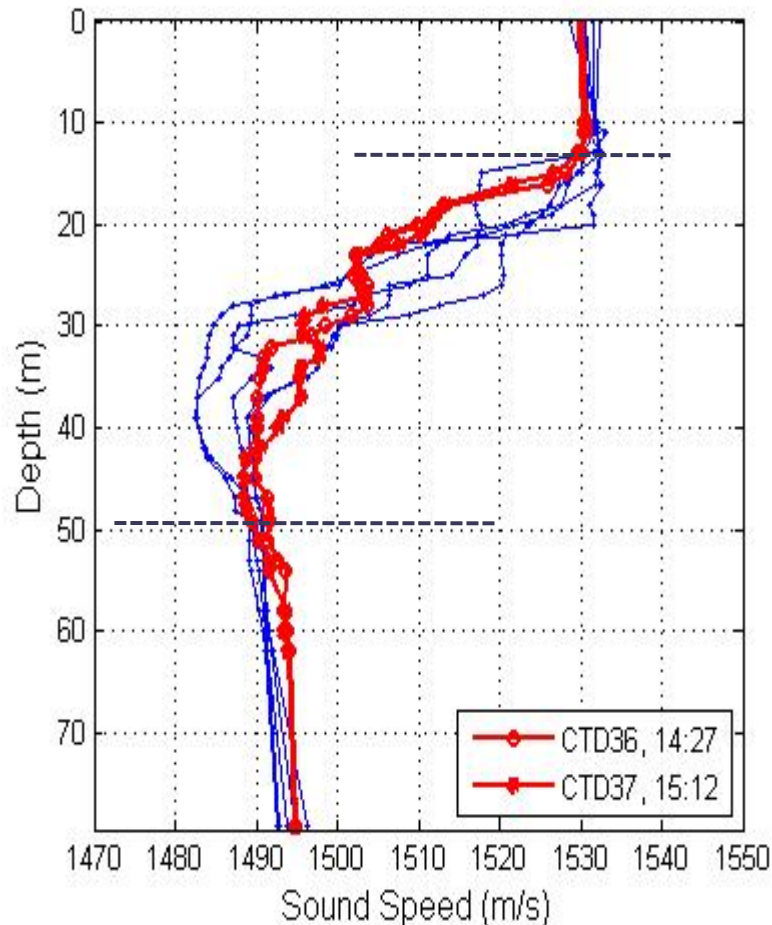


Travel time inversion



- ❖ The difficulties of reflection coefficient inversion
 - Signal amplitude fluctuation, micro-path interference in the direct arrivals
 - We need to treat each source depth data separately because of time varying SSP
- ❖ Travel time inversion procedure
 - experimental geometry at SD = 65 m: WD, R, SD and VLA tilt
 - at other source depths, invert for water column SSP
 - sediment sound speed and layer thickness at all source depths

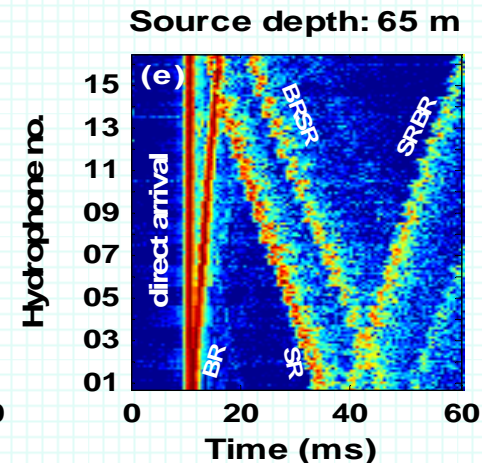
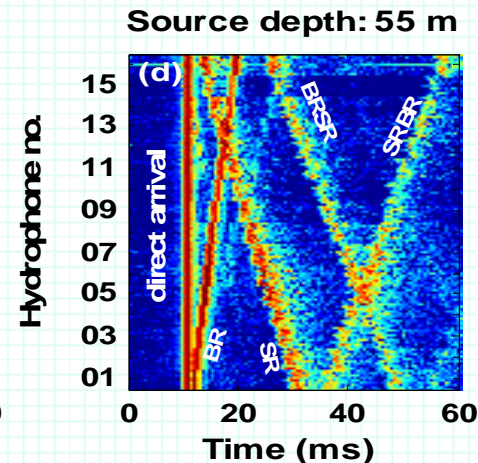
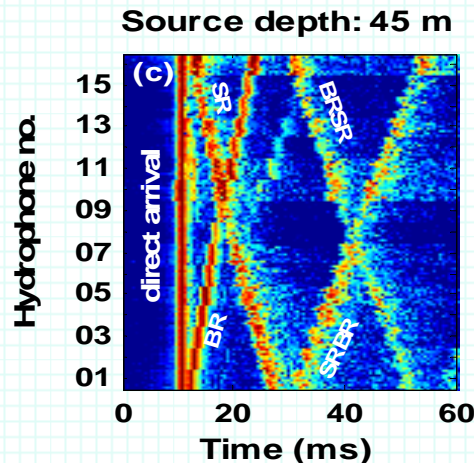
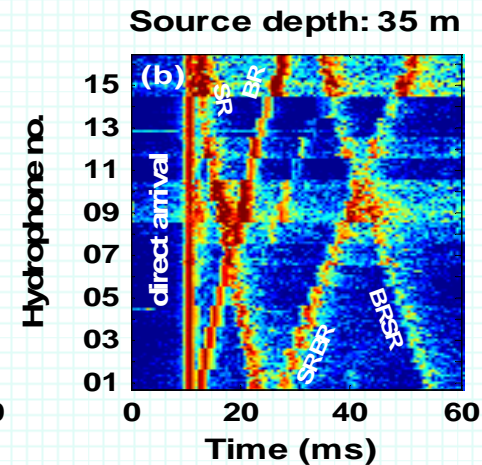
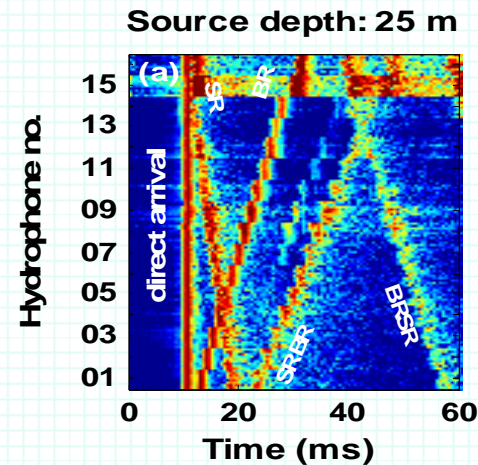
Environmental parameterization



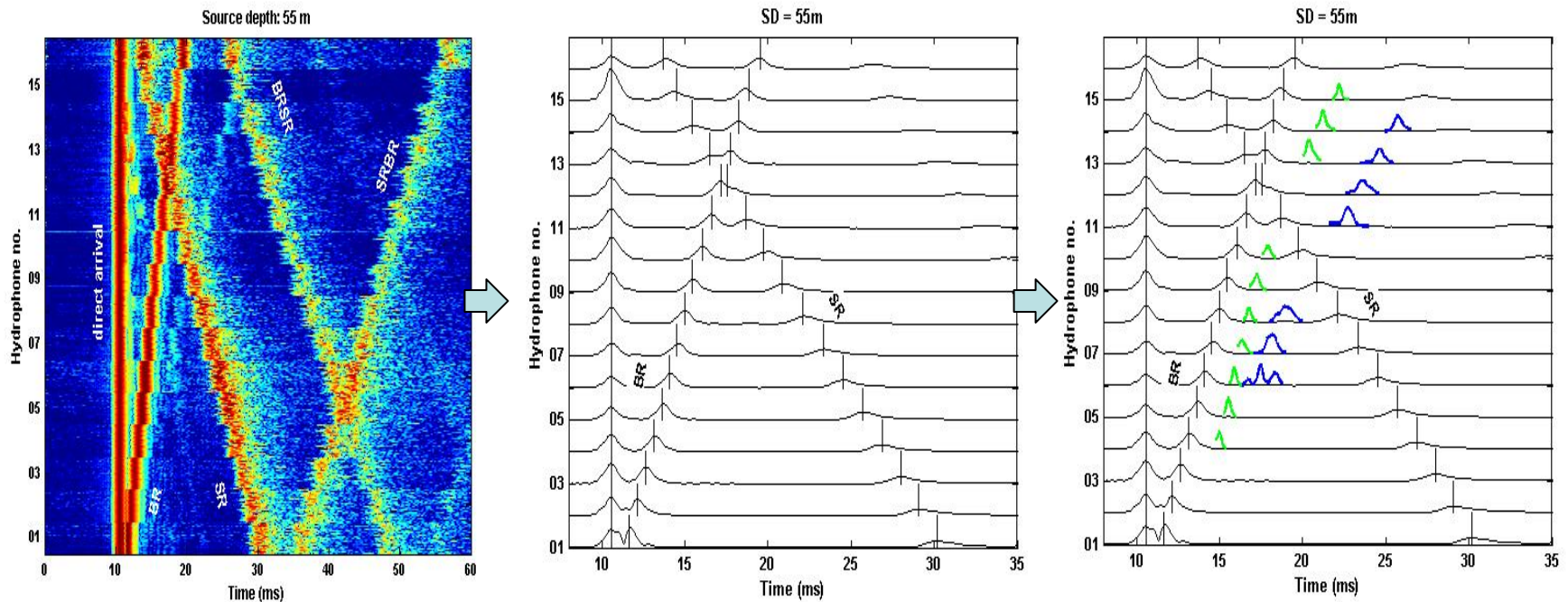
- Water column SSP is included in the inversion in terms of EOF
- SSP casts measured on JD239 + 2 SSPs measured before and after the experiment
- Fit only the thermocline region in the inversion
- Only the first 4 EOF coefficients are included in the inversion

Geoacoustic parameterization

Geoacoustic parameterization is based on the resolvable layers in the data



Geoacoustic parameterization continued...



Energy function, forward model and inversion algorithm

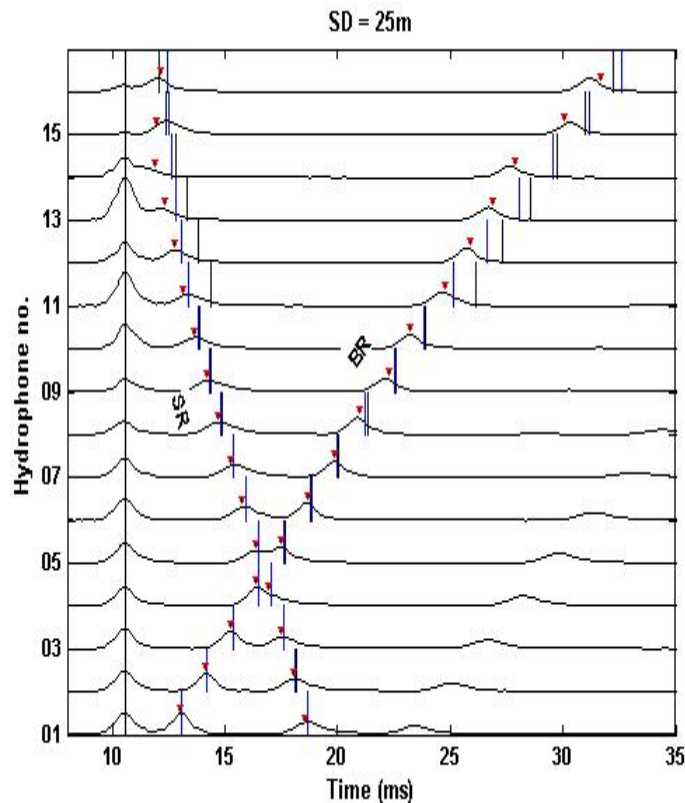
Energy function:

$$E(m) = \sum_{i=1}^{N_L} \sum_{j=1}^{N_H} (t_{i,j} - T_{i,j}(m))^2$$

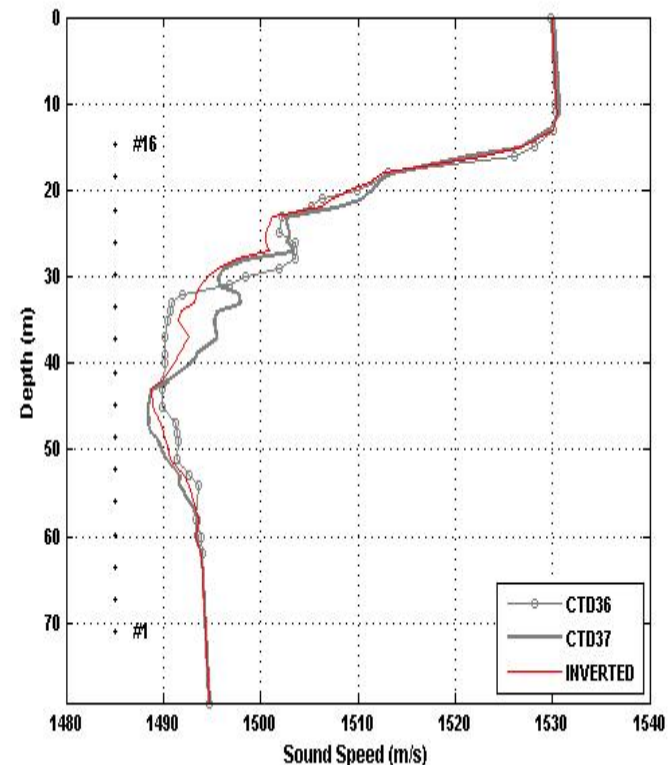
Forward model: Based on ray theory.

Inversion algorithm: Optimization algorithm - ASDE
(Adaptive Simplex Differential Evolution)
Embed downhill simplex (local search)
into differential evolution (global search)

Example of SSP inversion result

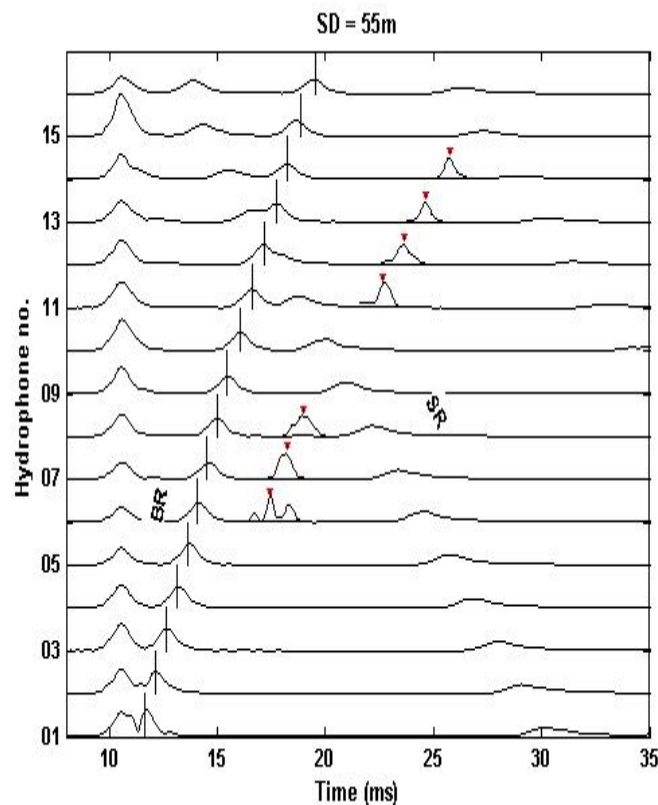


Travel time fit for SSP inversion

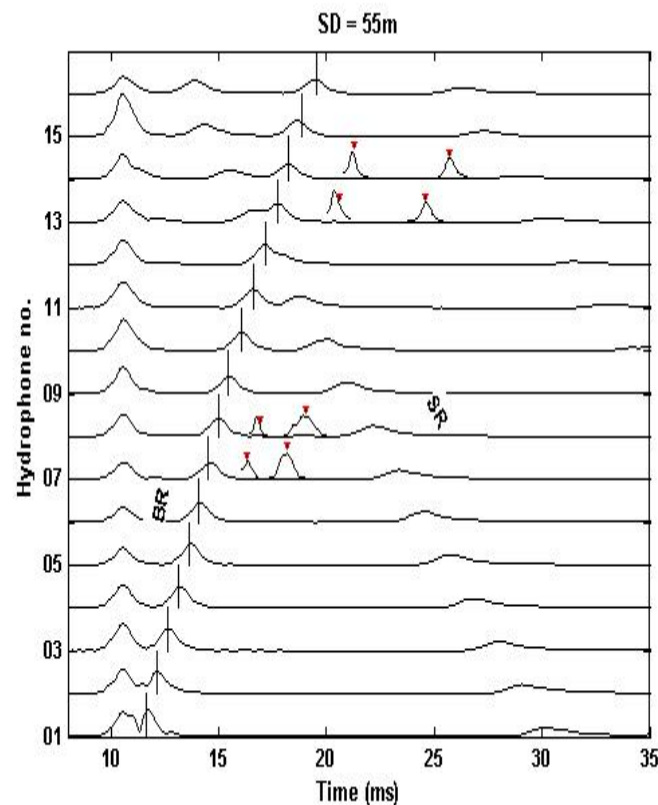


Inverted SSP for SD = 25 m data

Example of geoacoustic inversion result

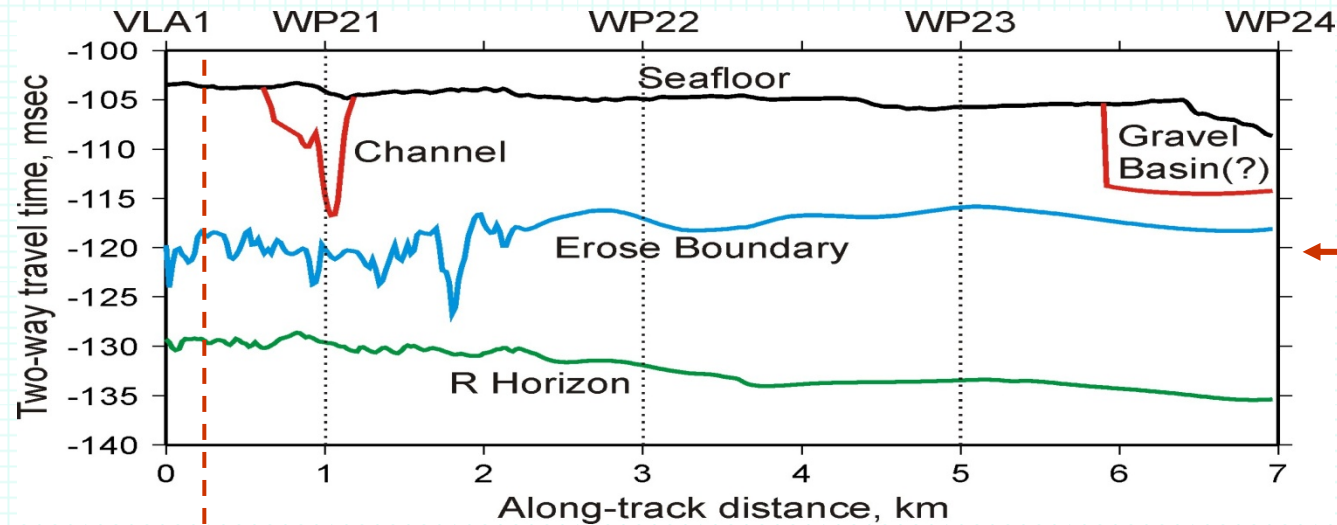


Travel time fit for 1-layer
geoacoustic inversion



Travel time fit for 2-layer
geoacoustic inversion

Comparison with geophysical survey data



From John Goff

TABLE I. Travel time inversion results for one layer over half space model

Parameter	Source depth				
	25 m	35 m	45 m	55 m	65 m
layer thickness (m)	21.5	20.6	22.3	22.3	20.4
sound speed (m/s)	1609	1597	1600	1600	1584
TWT (ms)	26.7	25.8	27.9	27.9	25.8

TABLE II. Travel time inversion results for two-layer over half space model

Source depth	layer I		layer II	
	sound speed	layer thickness	sound speed	layer thickness
55 m	1581 m/s	11.9 m	1602 m/s	9.1 m
65 m	1584 m/s	14.5 m	1611 m/s	8.4 m

Summary

- Water column SSP has great impact on geoacoustic inversion. SSP in terms of EOFs included in the inversion (geometric, geoacoustic parameters)
- The limitation
- Future work
Quantify the uncertainty of the estimates

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