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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

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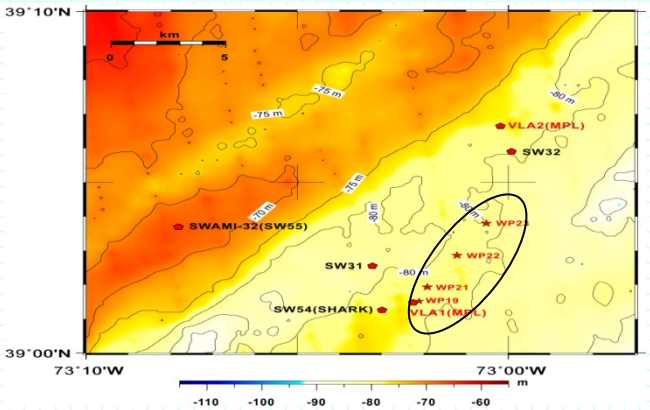

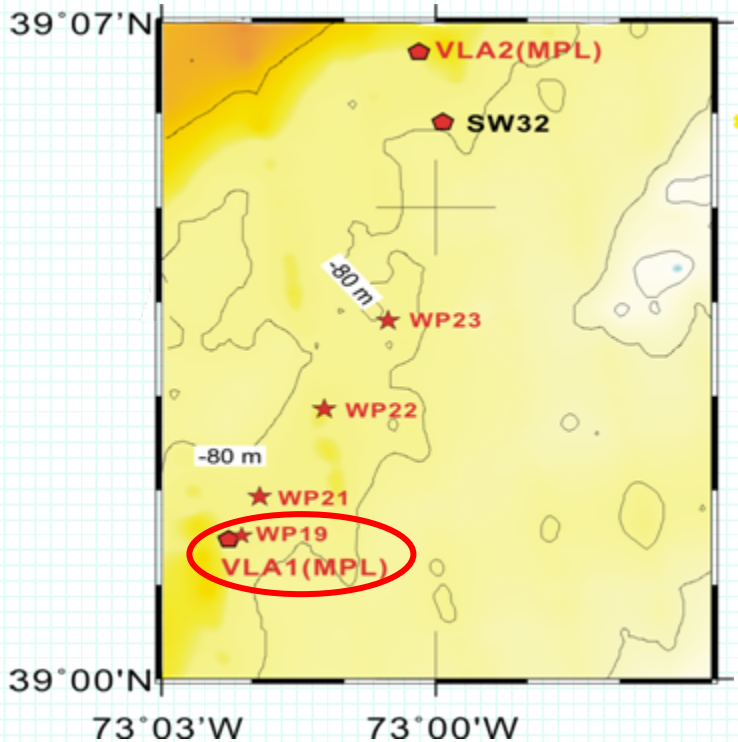

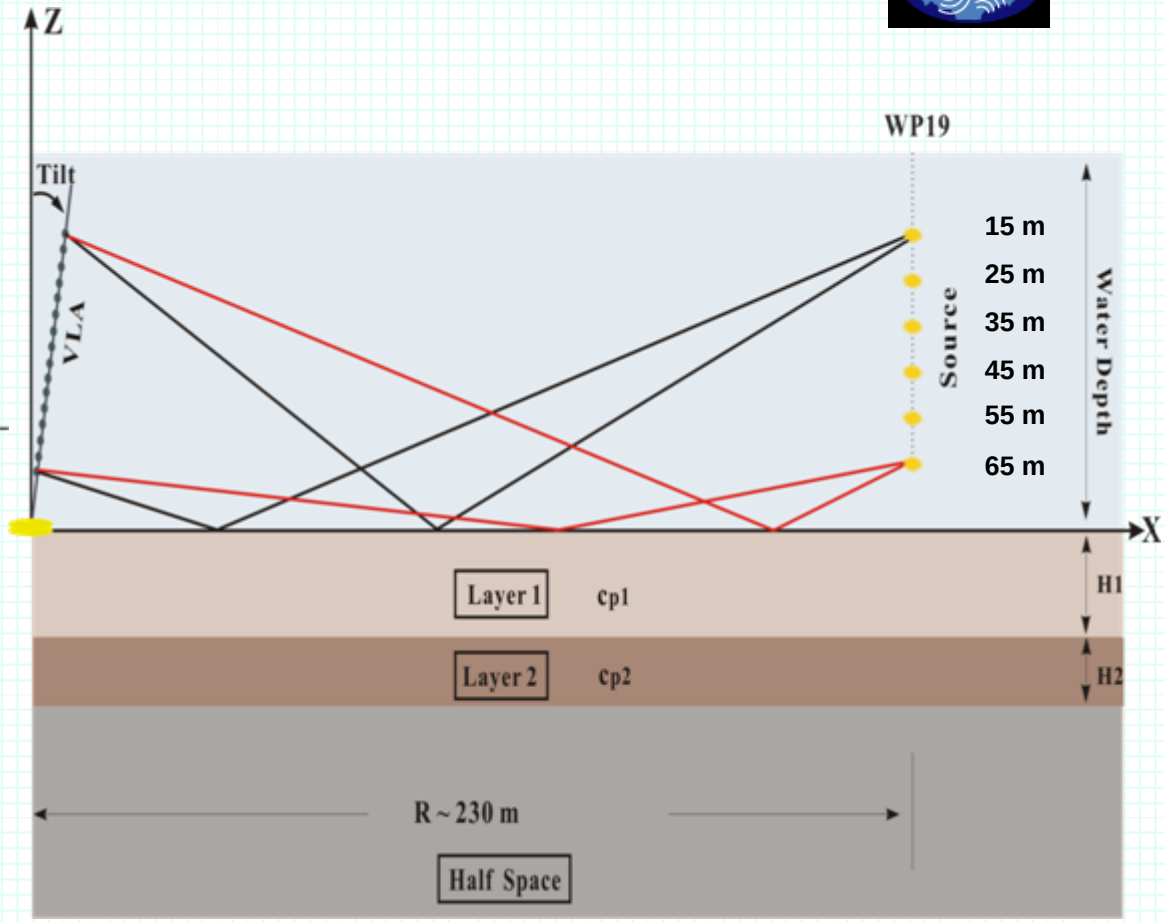

The time varying oceanic SSP

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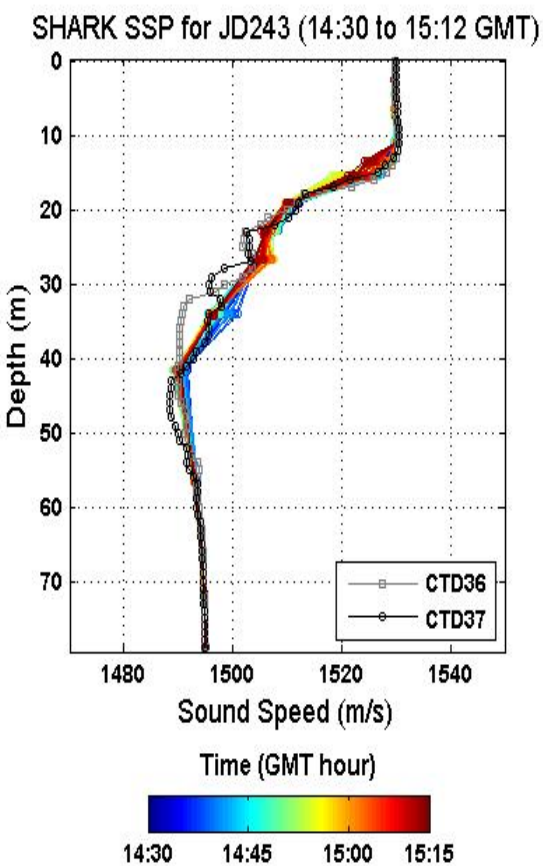
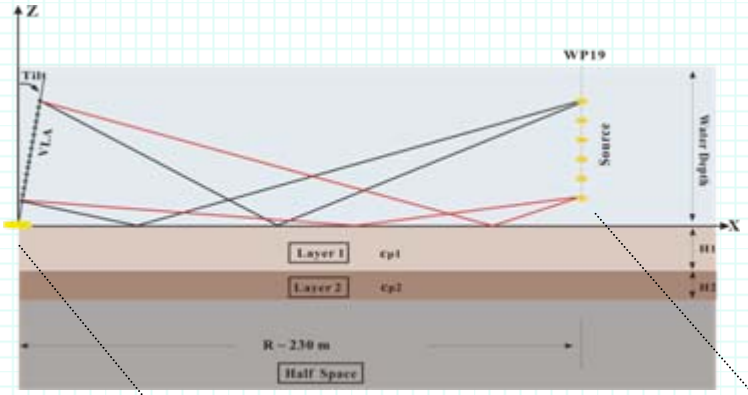
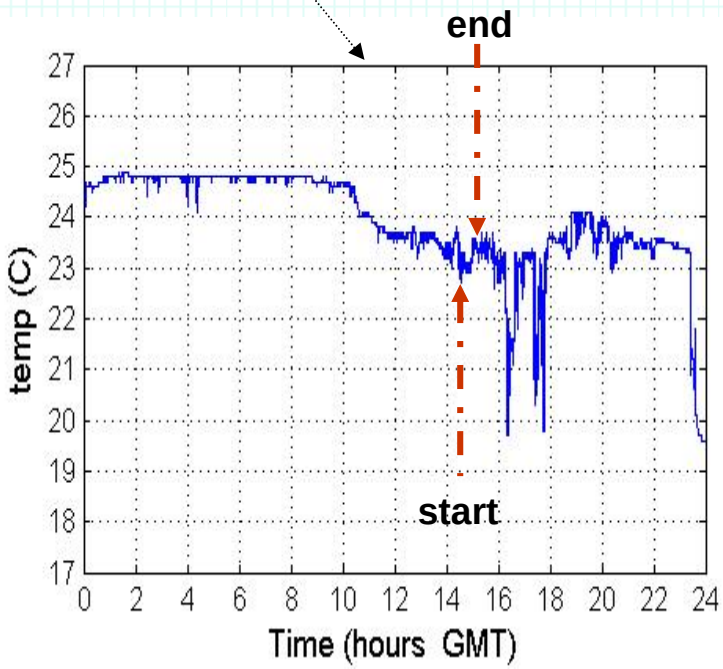
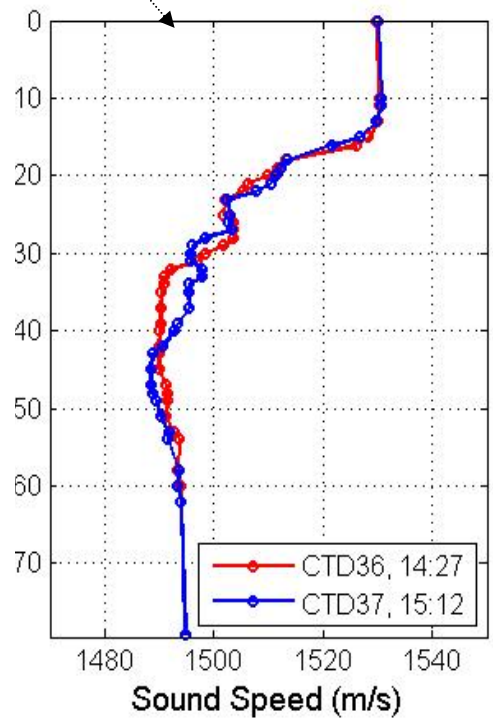
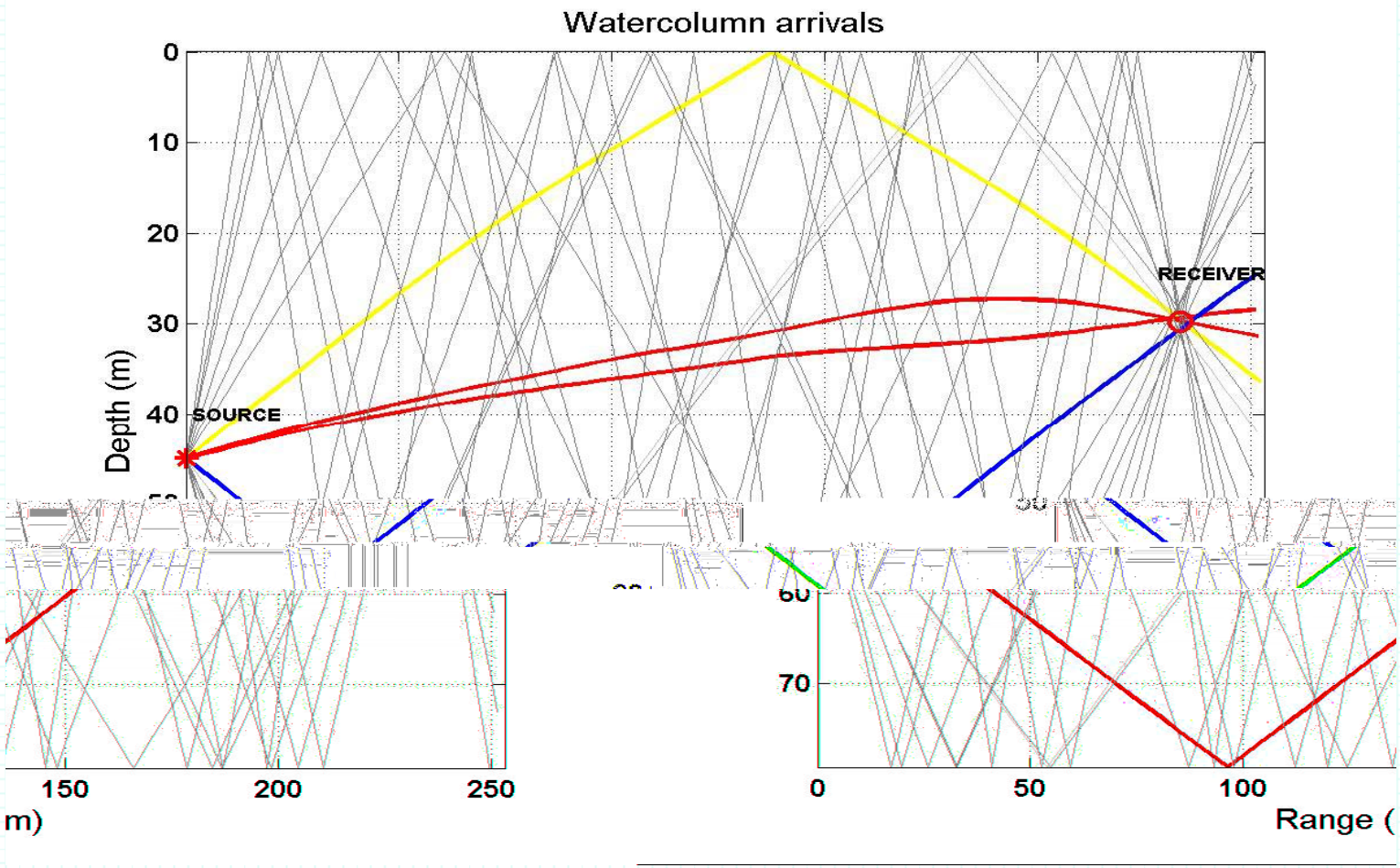




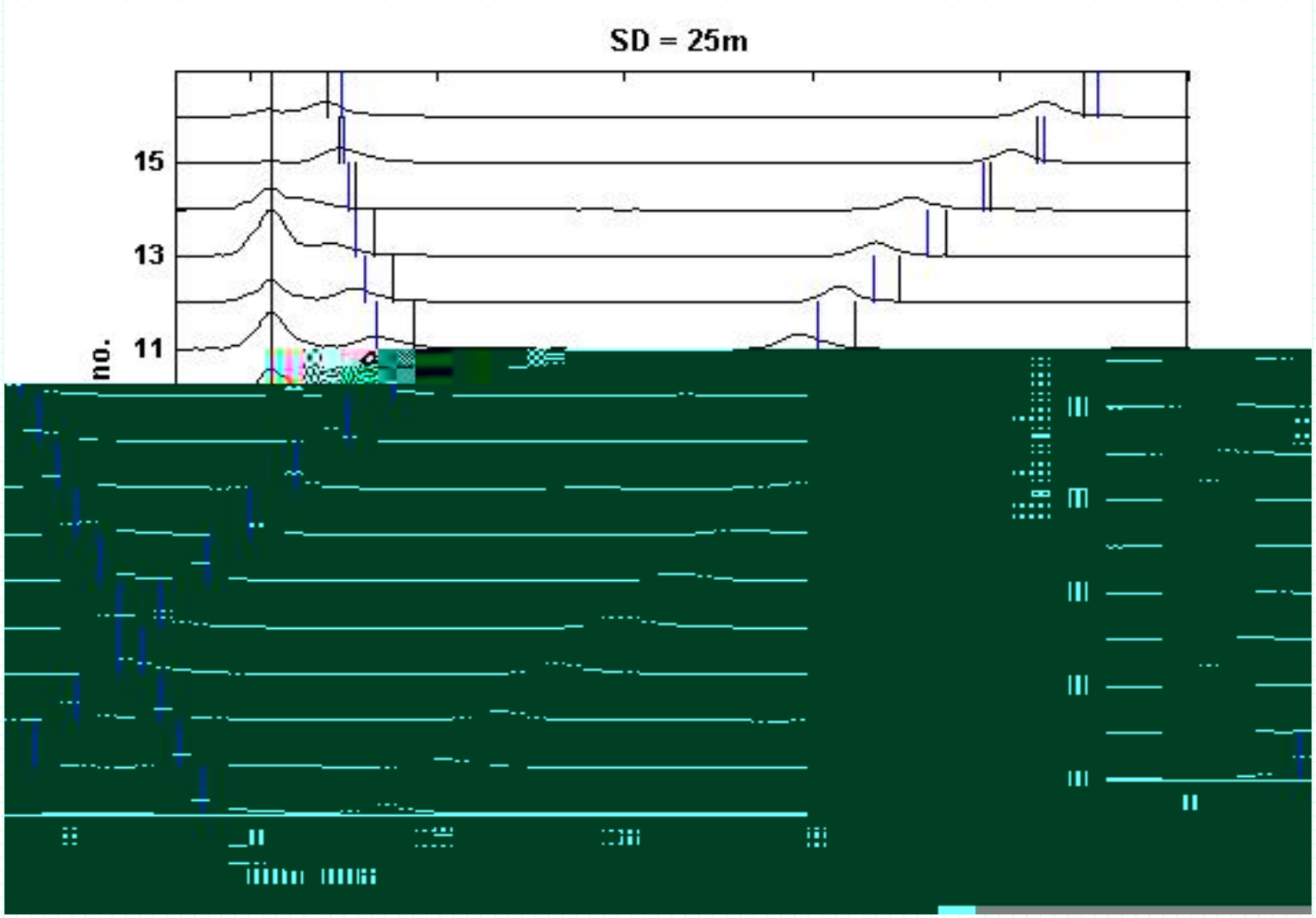




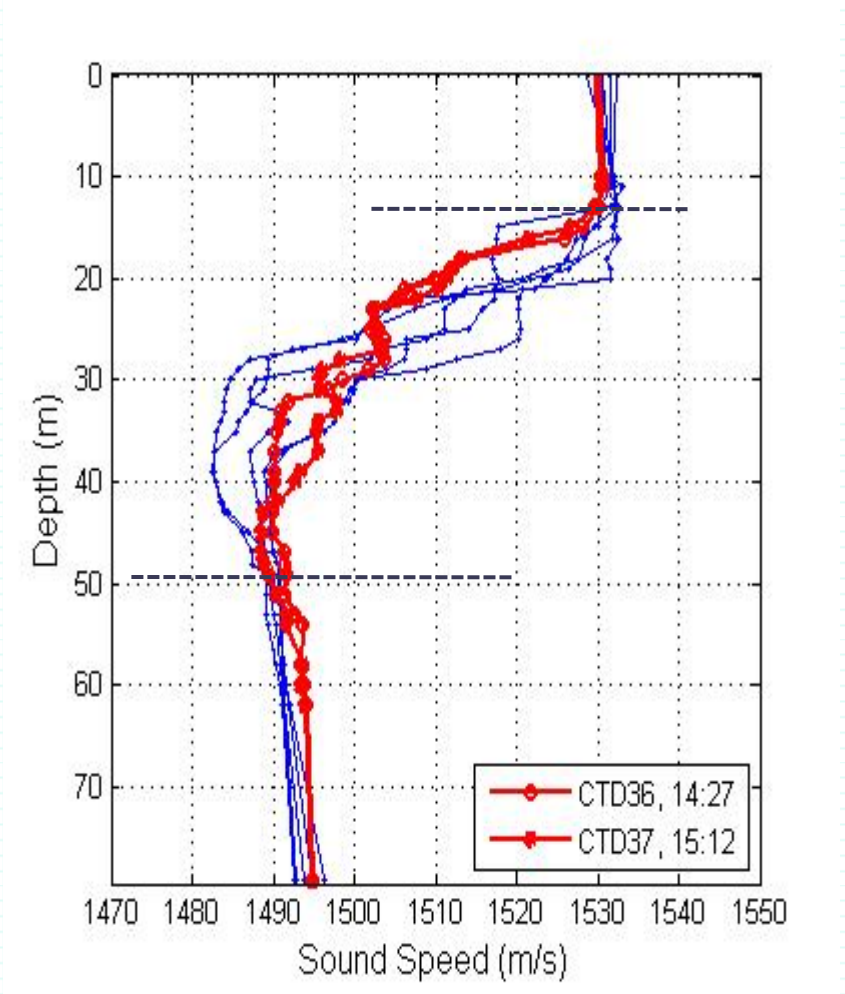
The effect of SSP on signal amplitude



The effect of SSP on arrival time



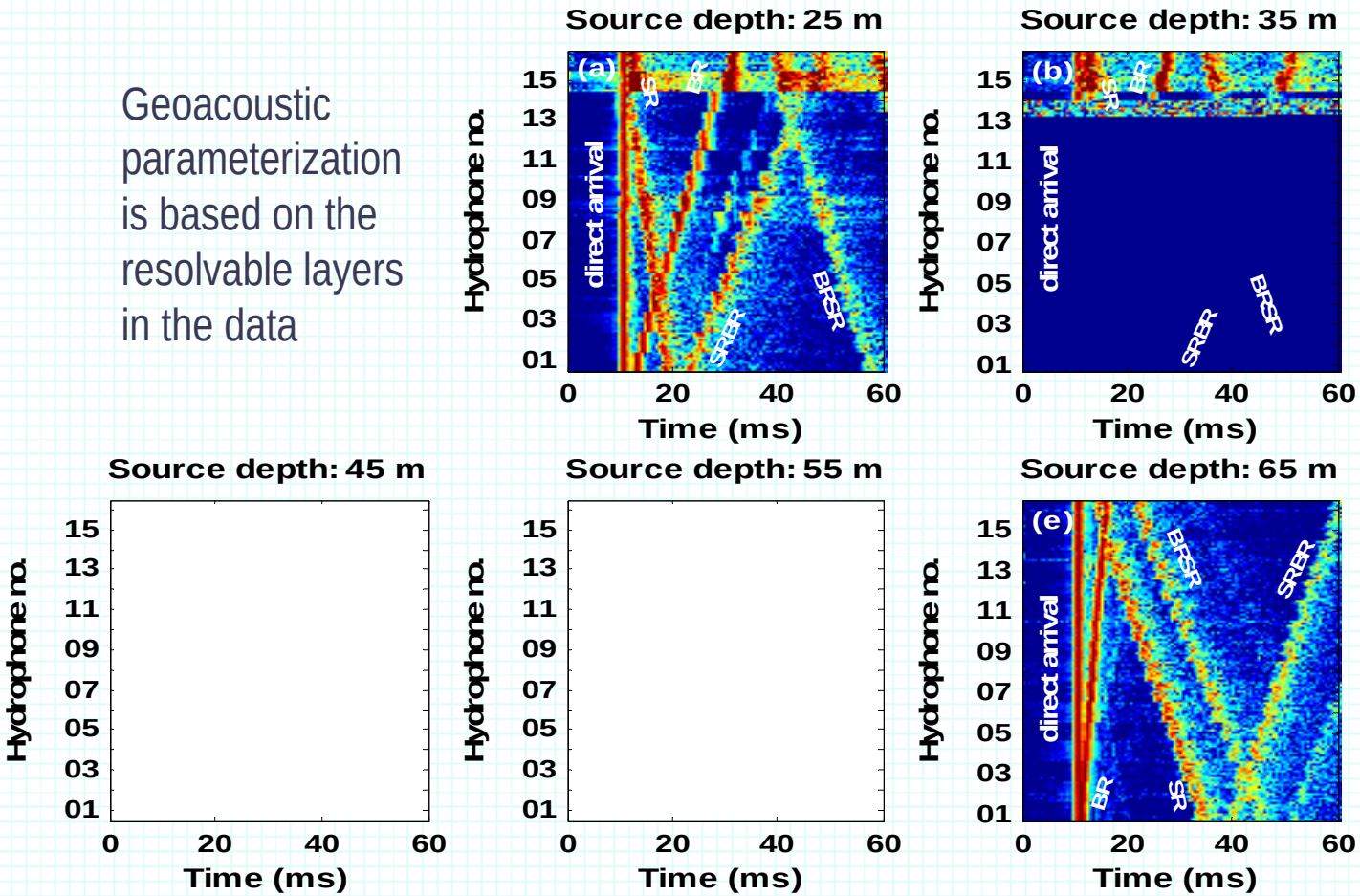
Environmental parameterization



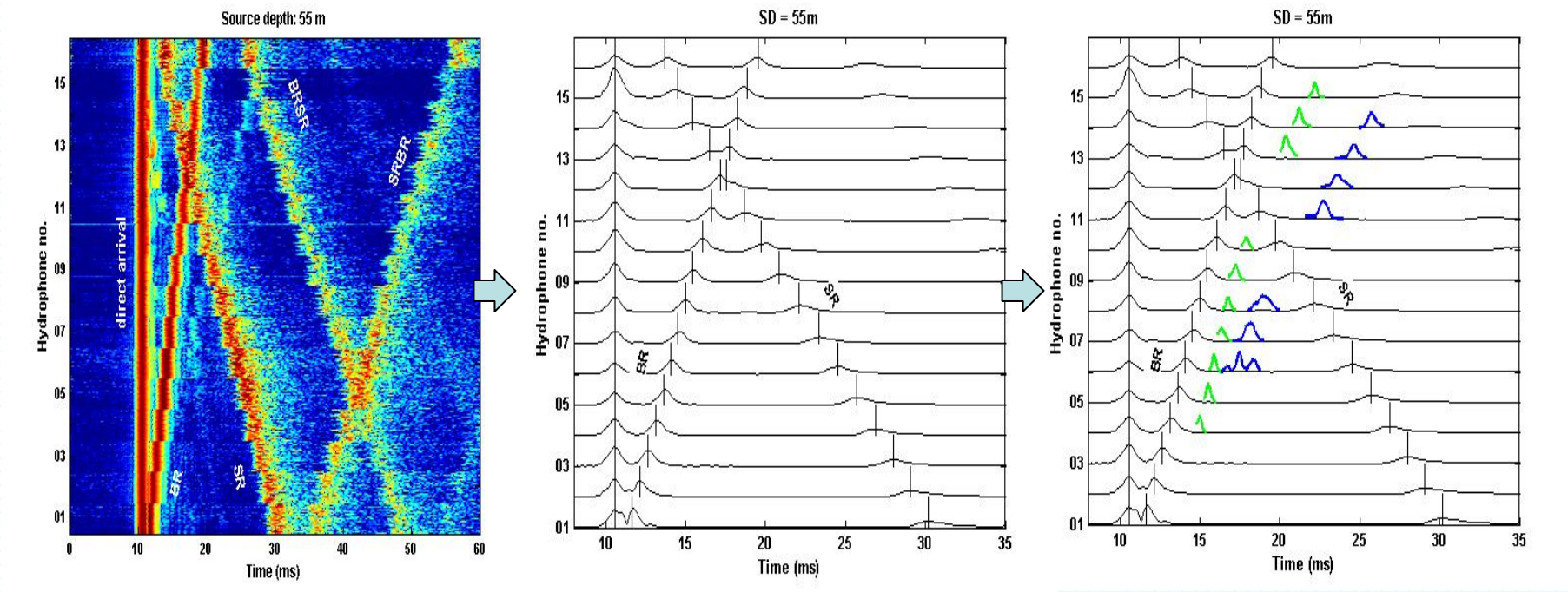
- Water column SSP is included in the inversion in terms of EOF
- SSP casts measured on JD239 + 2 SSPs measured before and after the experiment
- Fit only the thermocline region in the inversion
- Only the first 4 EOF coefficients are included in the inversion

Geoacoustic parameterization

Geoacoustic parameterization is based on the resolvable layers in the data



Geoacoustic parameterization continued…



Energy function, forward model and inversion algorithm

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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

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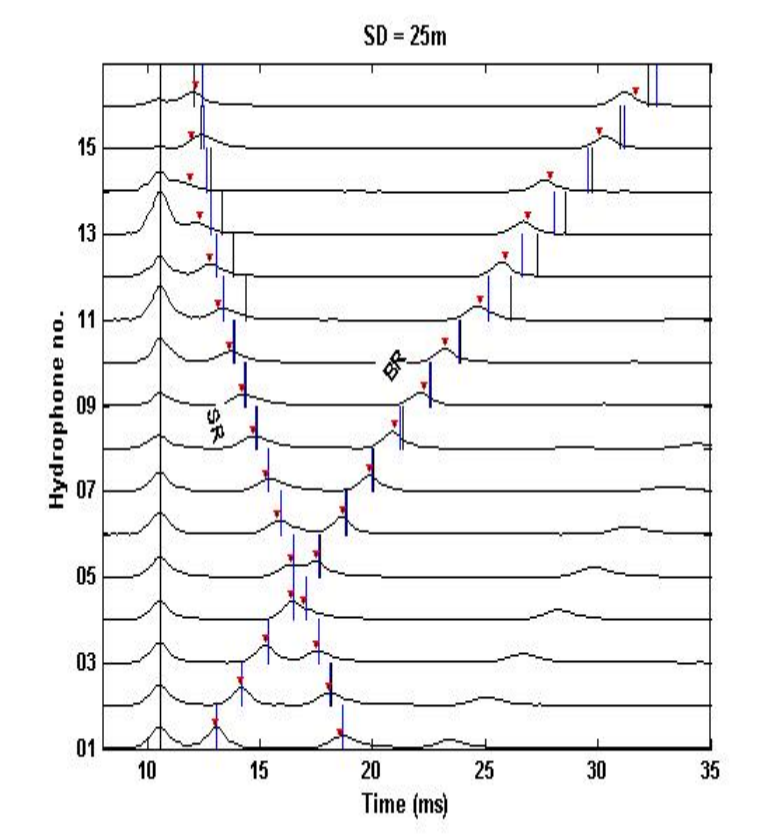
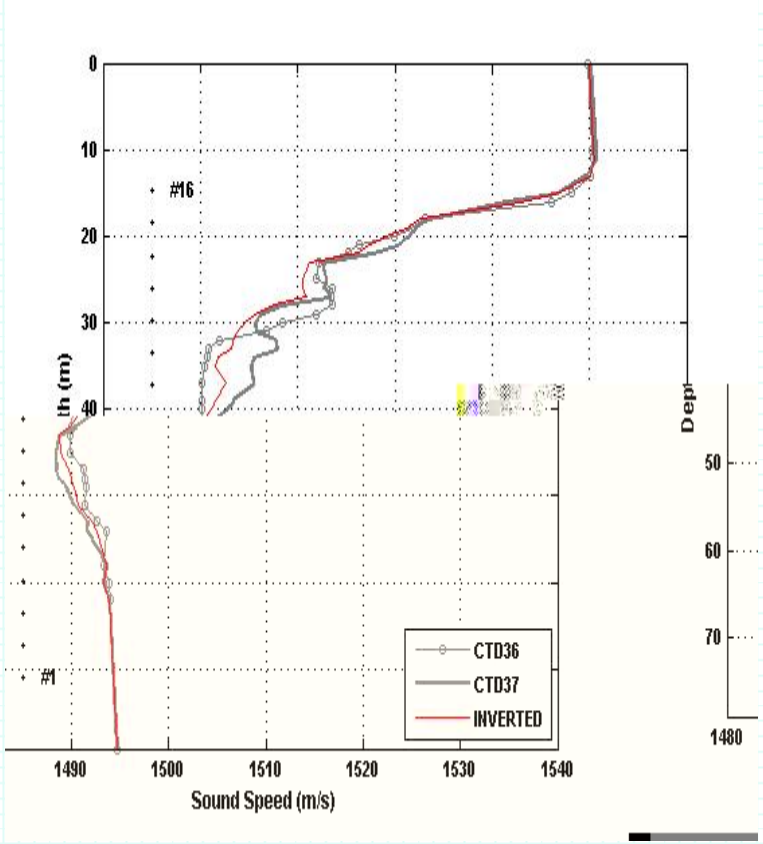


Travel time fit for SSP inversion



Inverted SSP for SD = 25 m data

Comparison with geophysical survey data

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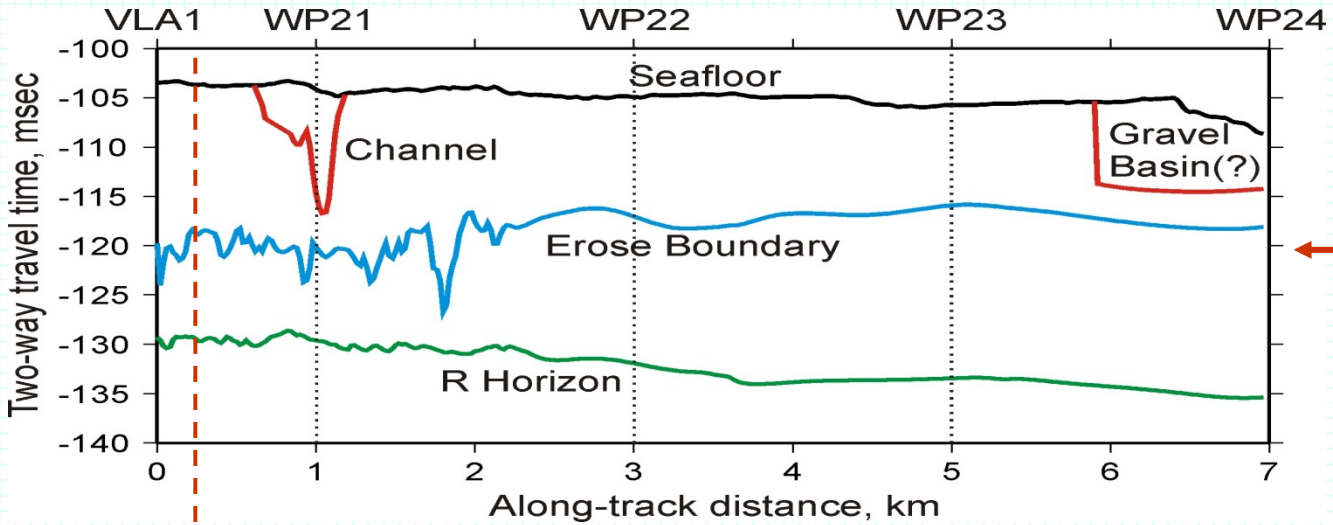

From John Goff

WP19, ~ 230 m

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

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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

Acknowledgements

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