Mid-Frequency Bottom interaction measurements off the New Jersey continental shelf

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SHALLOW WATER 2006

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Mid-to-High frequency Bottom reflected signal measurements

Mid-to-High frequency Sea Surface scattered signal measurements

Mid frequency propagation measurements

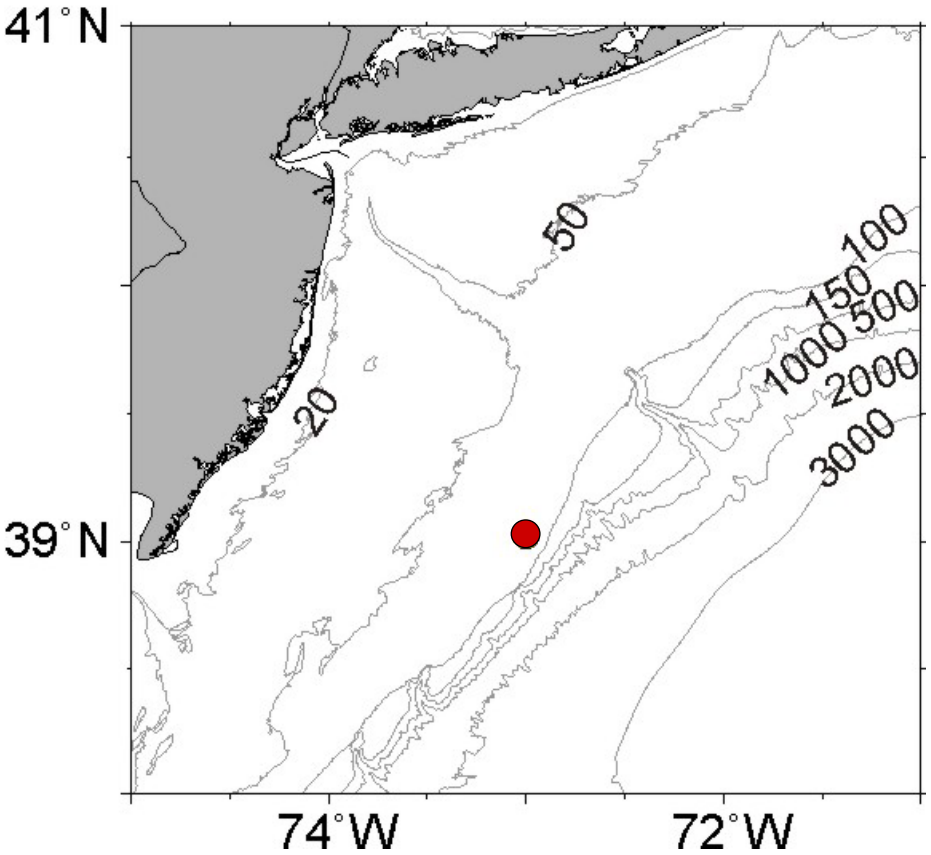
Sediment sound speed measurements

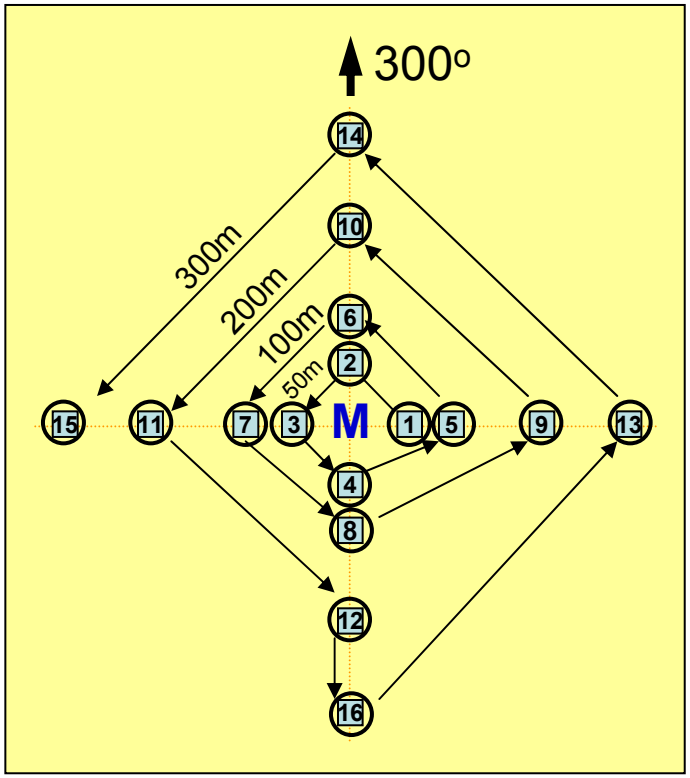
Sediment roughness measurements

Supported by ONR, with partial support from Hanyang Univ.

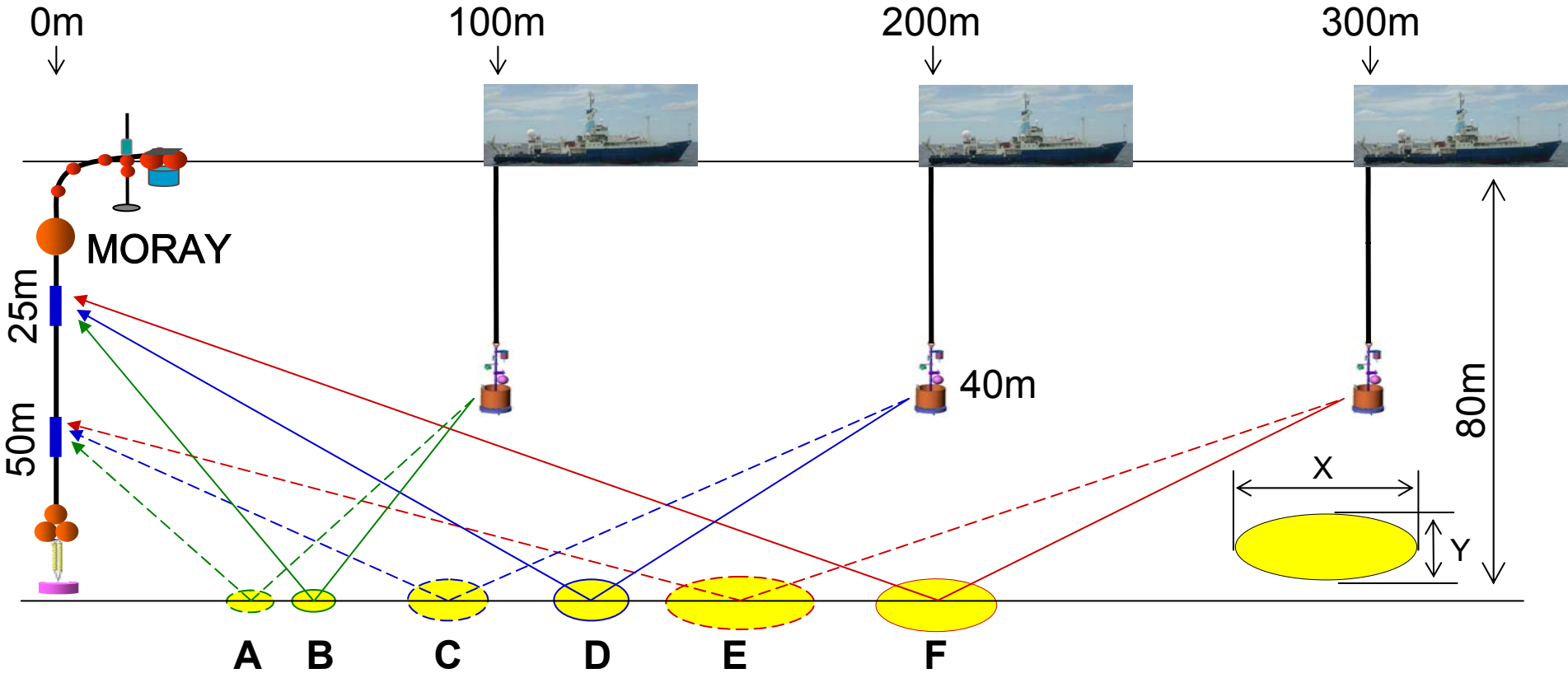
SW'06 experimental site

SITE: 39.0245 N, 73.0377 W
WATER DEPTH : ~ 80 m (Flat bottom)





BOTTOM REFLECTION



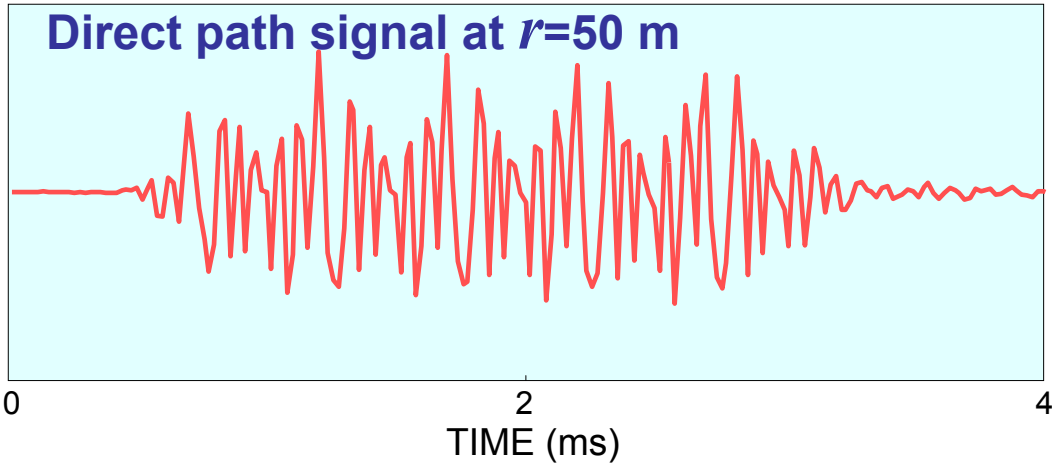
X × Y : size of 1st Fresnel zone (m)

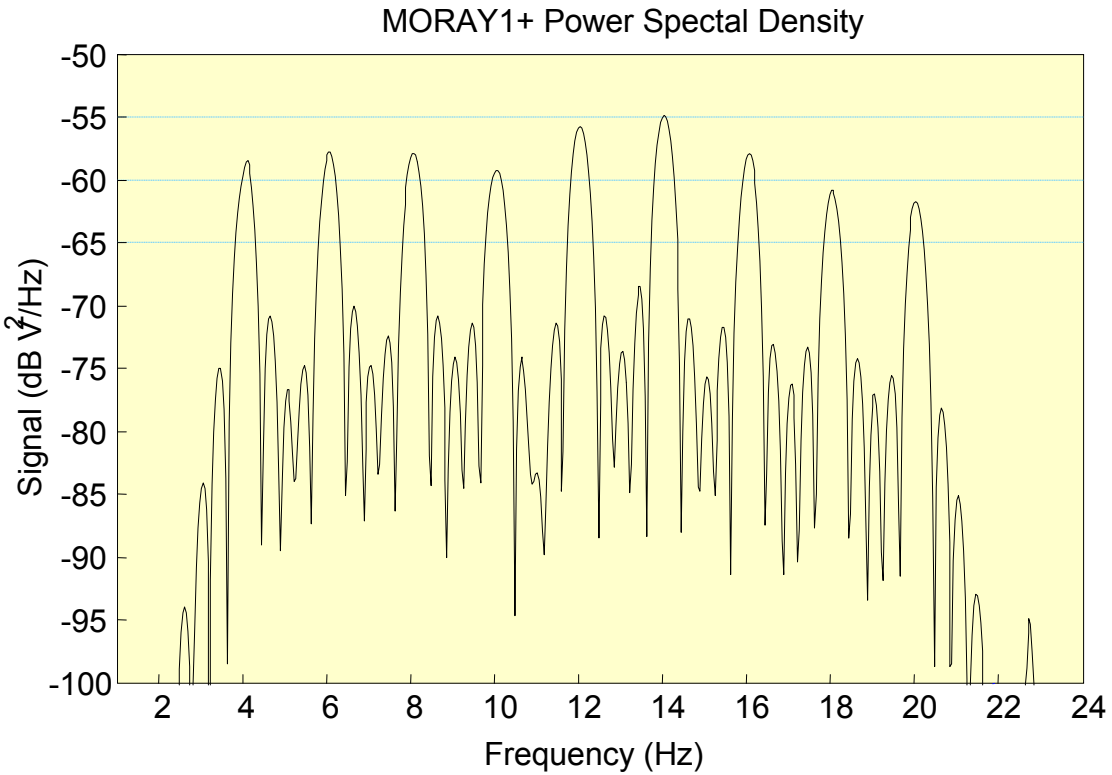
	A	B	C	D	E	F
Grazing angle	35°	43.5°	19.5°	25°	12.5°	17°
1 kHz	17 × 12	13 × 12	47 × 17	35 × 17	86 × 21	64 × 21
20 kHz	4 × 3	3 × 3	11 × 4	8 × 4	20 × 5	15 × 5

Source Signals

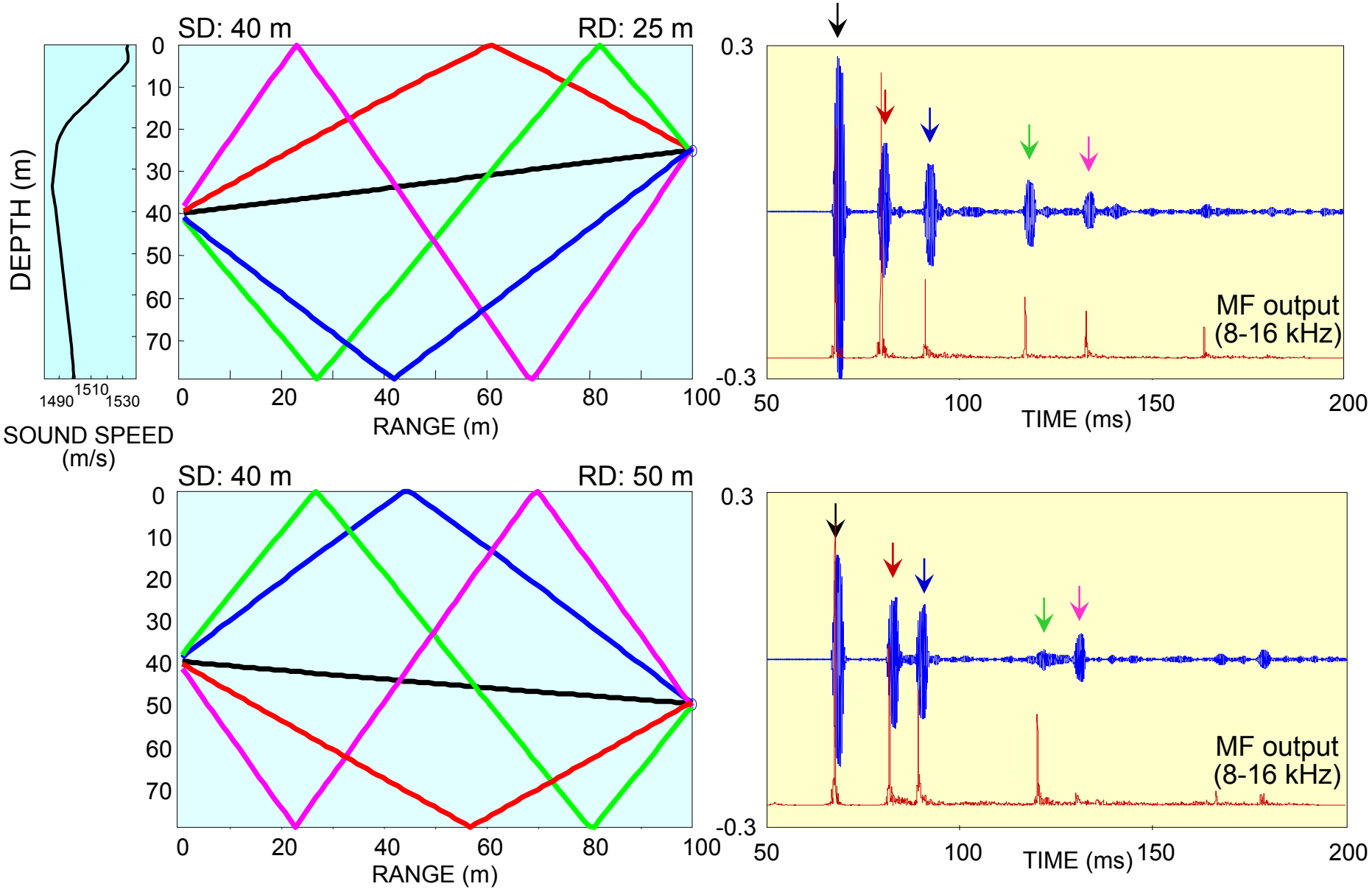
1-4 kHz(1, 2, 3, 4 kHz), 5 ms
4-20 kHz(4, 6, 8, 10, 12, 14,
16, 18, 20 kHz), 3 ms

CW (superimposed) signal

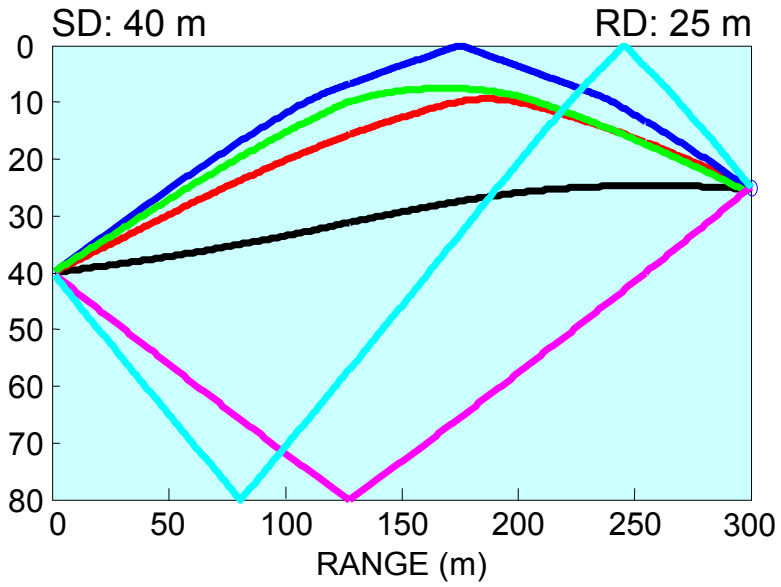


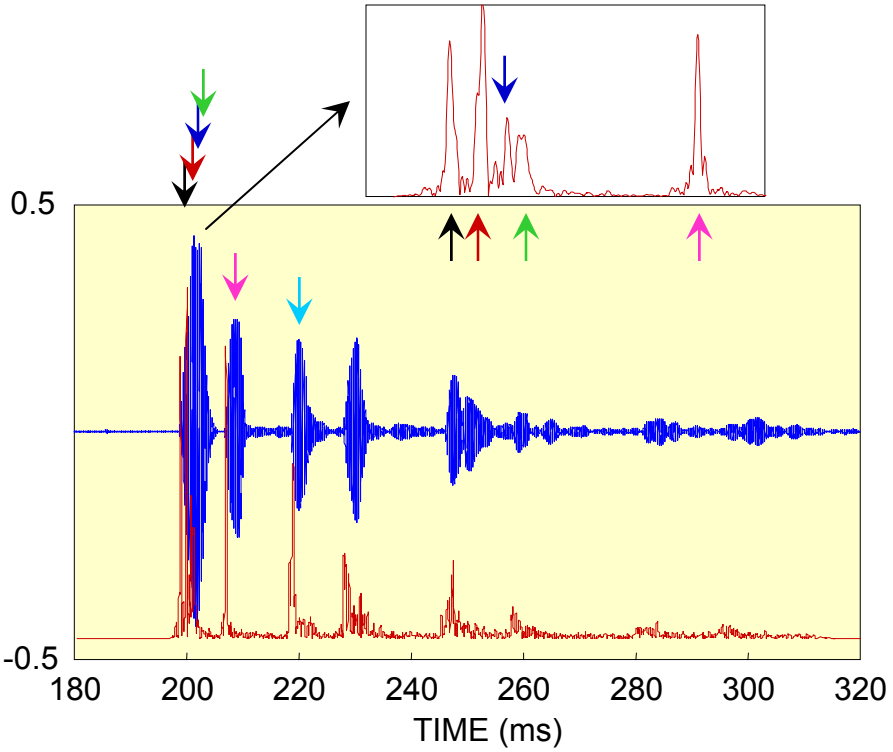


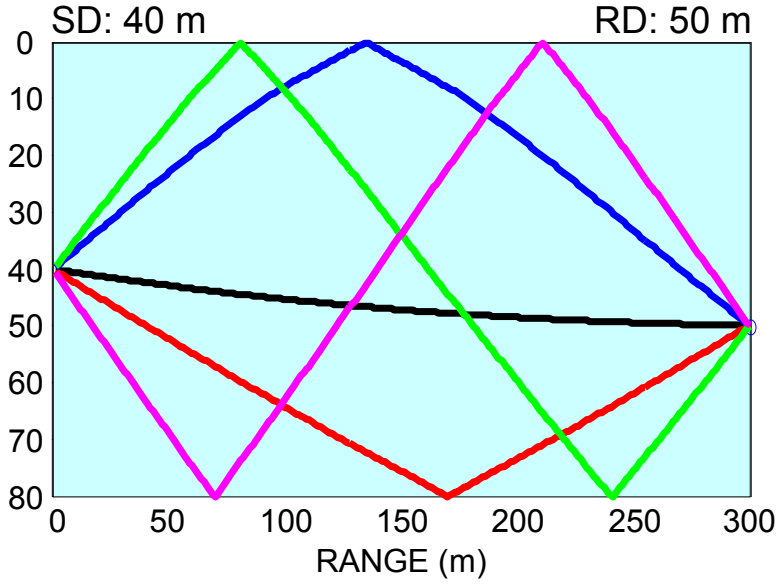
r=100 m, 10 kHz

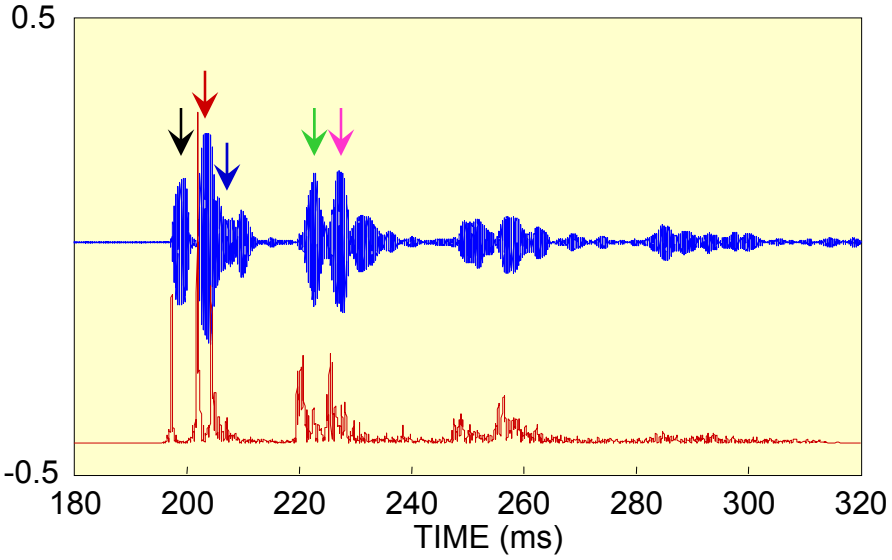

SD: 40 m
RD: 25 m
DEPTH (m)
0
10
20
30
40
50
60
70
1490
1510
1530
SOUND SPEED (m/s)
0
20
40
60
80
100
RANGE (m)
0.3
-0.3
50
100
150
200
TIME (ms)
MF output (8-16 kHz)
SD: 40 m
RD: 50 m
0
10
20
30
40
50
60
70
0
20
40
60
80
100
RANGE (m)
0.3
-0.3
50
100
150
200
TIME (ms)
MF output (8-16 kHz)

r=300 m, 10 kHz

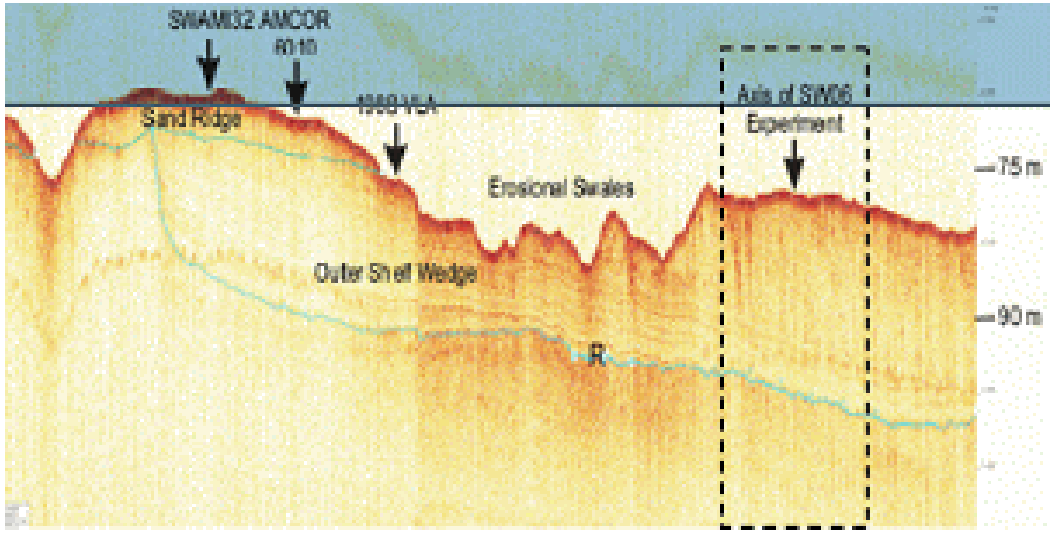

SD: 40 m
RD: 25 m
0
10
20
30
40
50
60
70
80
0
50
100
150
200
250
300
RANGE (m)


0.5
-0.5
180
200
220
240
260
280
300
320
TIME (ms)


SD: 40 m
RD: 50 m
0
10
20
30
40
50
60
70
80
0
50
100
150
200
250
300
RANGE (m)


0.5
-0.5
180
200
220
240
260
280
300
320
TIME (ms)

Sediment structure : SW'06 experiment site



N. R. Chapman and Y.-M. Jiang, "Geoacoustic inversion results from SW06 data–long range vs. short range," ONR SW06 Workshop, Fort Lauderdale, FL, USA, 2008.

65 kHz in situ probes: Surficial sediment → medium-coarse sand, ~1.0-1.3ϕ), 1720-1740 m/s

Ref.) Goff et. al., Mar. Geol., 209, 147-172, (2004)

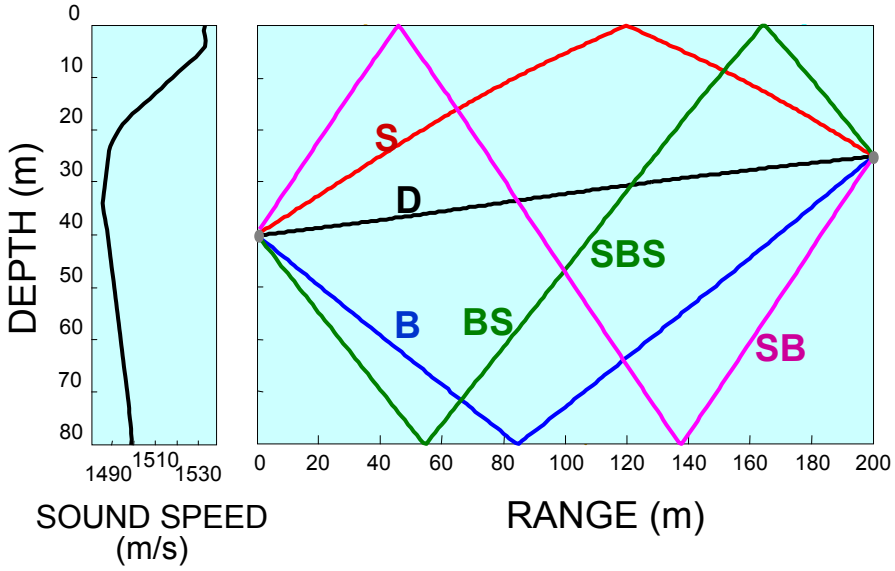
Coring: Thickness of surficial sediment ~20 cm
lower layer → very clay rich (~1630-1660 m/s) sediment

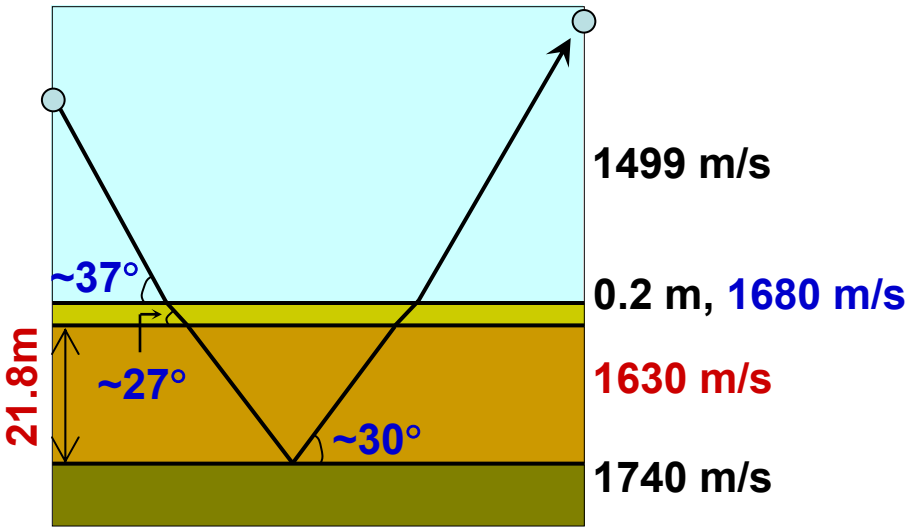
Ref.) Fulthorpe and Austin, Geology, 32, 1013-1016, (2004)

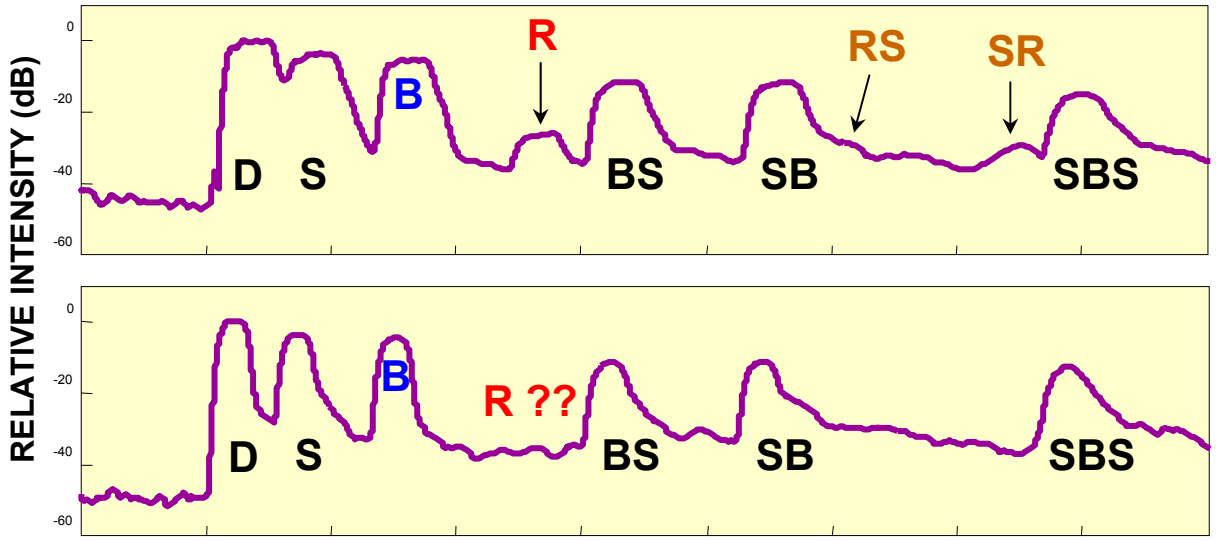
Two Observations : 1) Reflection from R-reflector

2) Reflection from the surficial layers

MEASUREMENTS







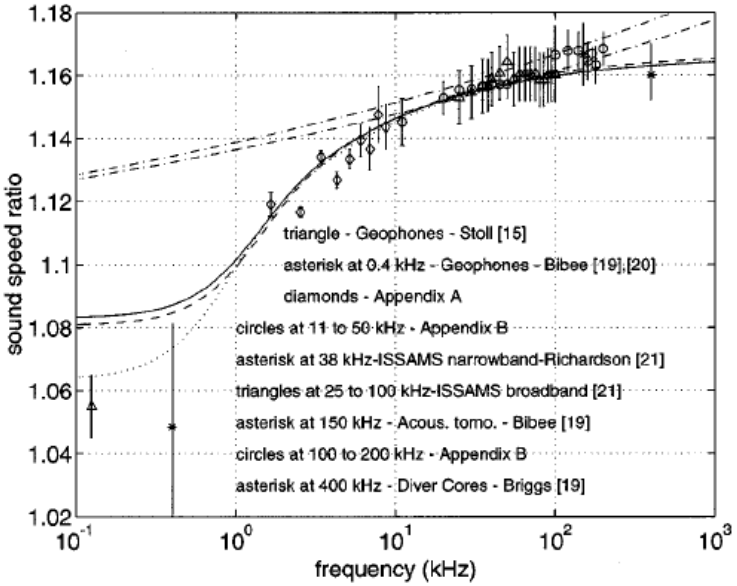
2 kHz

Measurements

6 kHz

GEOACOUSTIC PARAMETER ESTIMATE

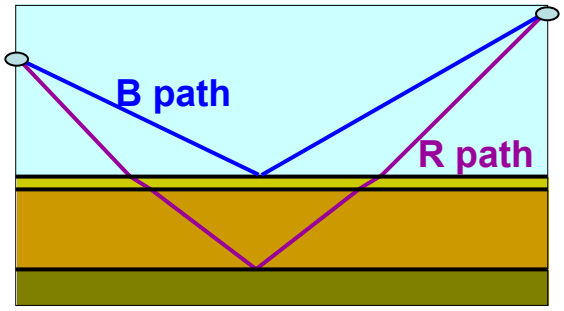
1. 1st layer : 1680 m/s at 2 kHz, 1730 m/s at 65 kHz



(Dispersion effect for sediment sound speed)

Ref.) K. L. Williams, et. al. (2002)
IEEE J. Ocean. Eng. 27, 413-428

2. 2nd layer : from the travel time difference between B & R paths

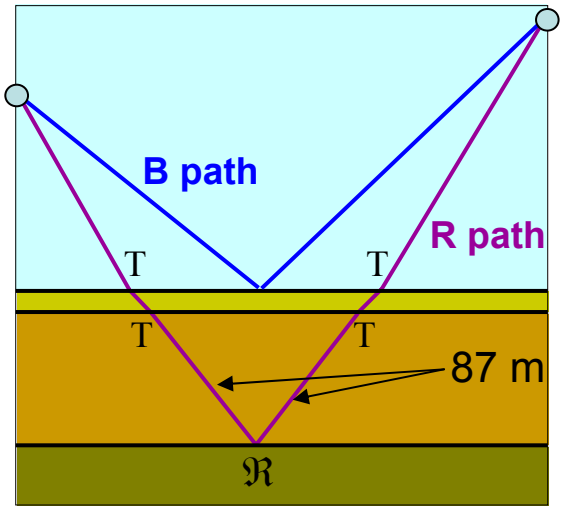


Thickness (21.8 ± 1 m)
Sound speed (1630 ± 20 m/s)

GEOACOUSTIC PARAMETER ESTIMATE

3. Attenuation of 2nd layer : α = 0.05 $\pm$ 0.01 dB/m/kHz

From the amplitude ratio between B & R path for freq. 1-4 kHz.



(assumption: $\Re$, T are constant for 1-4 kHz and

Total path length within 2nd layer is 87 m.

Most attenuation in 2nd layer (20 m)

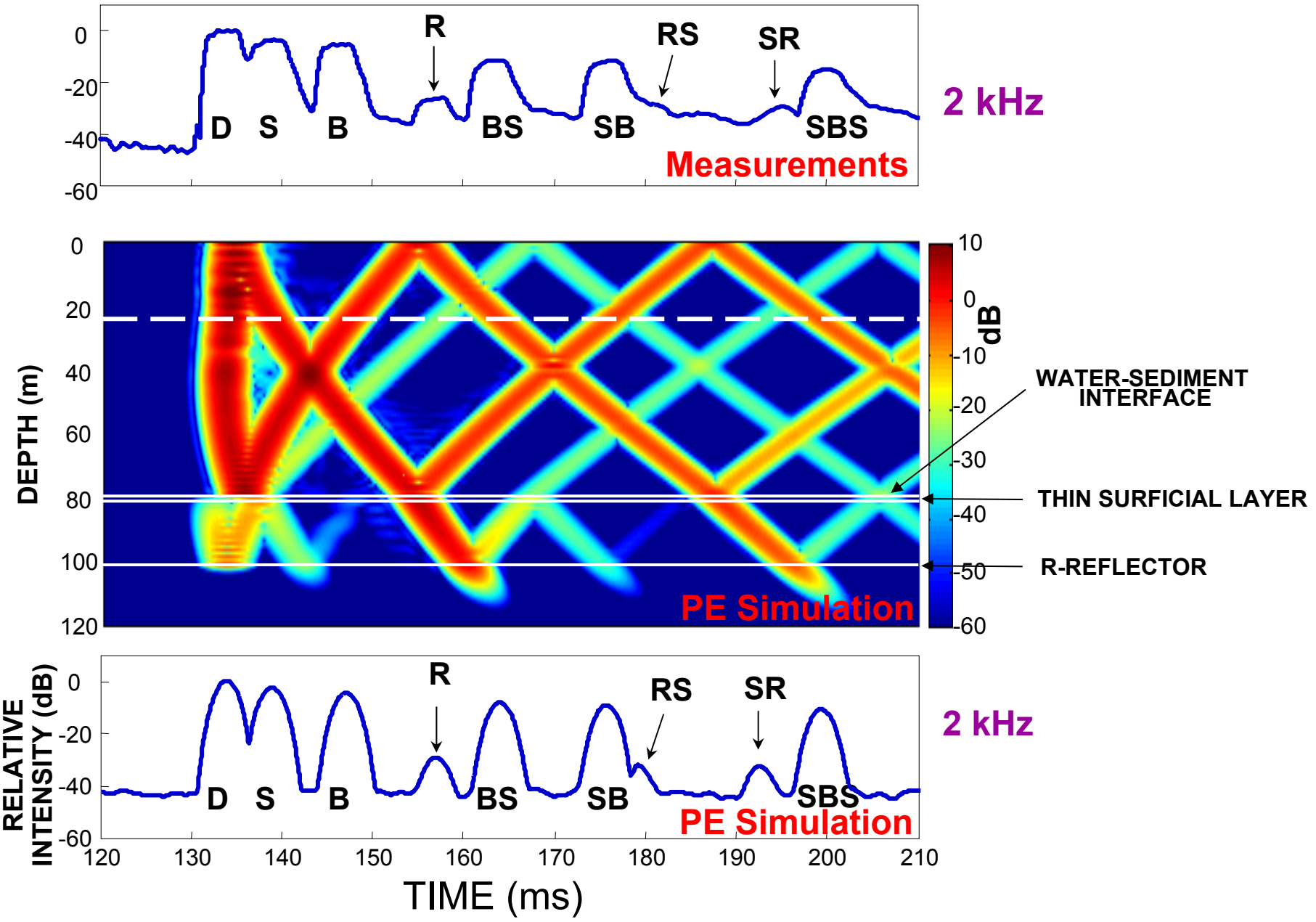
4. Densities for 1st & 2nd layers assumed to be 2.1 and 2.0 g/cm^3, respectively.

Ref.) Goff et. al. (2007) JASA 122 2983

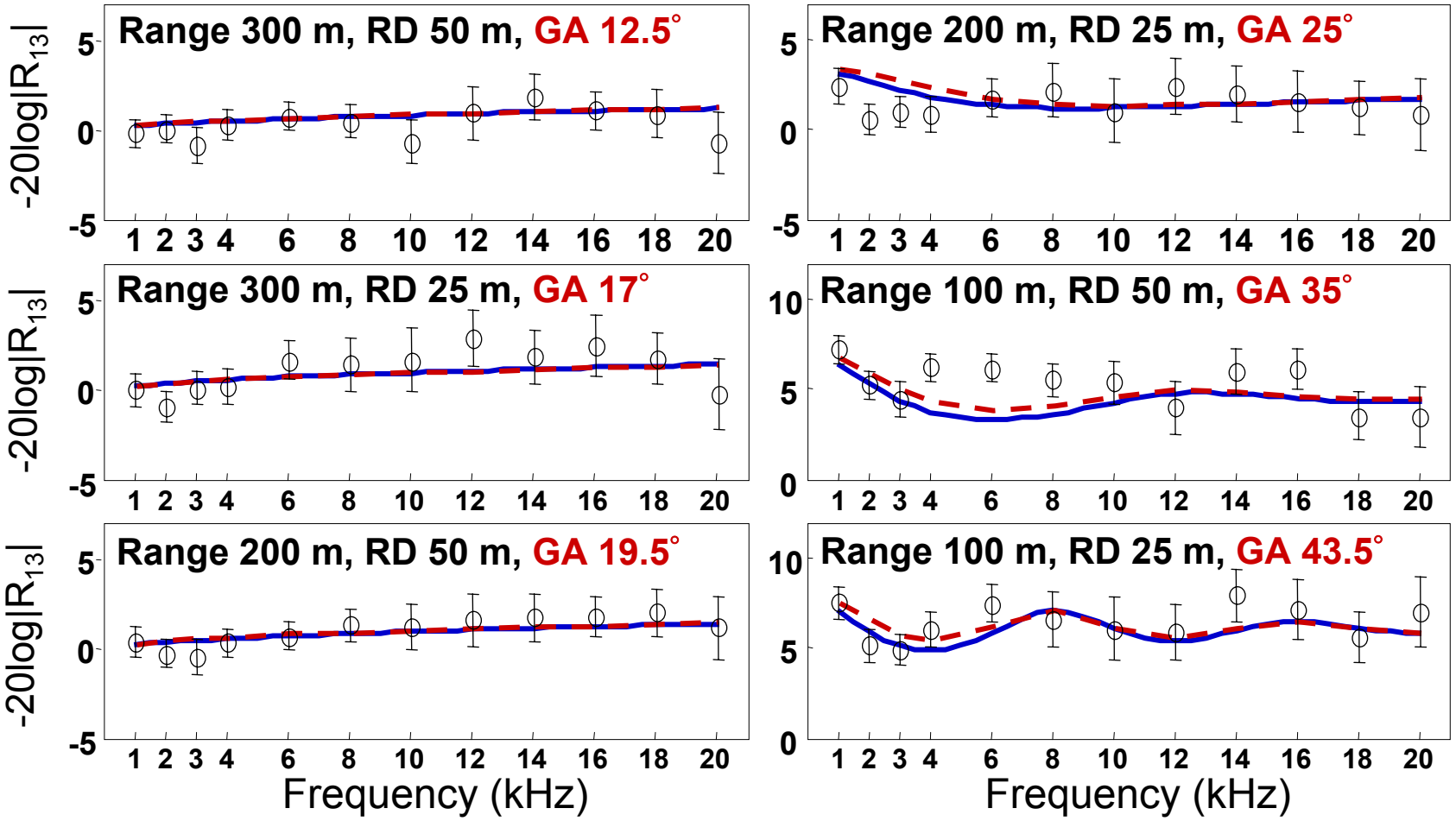
5. R reflector as Half-space with 1740 m/s, 2.2 g/cm^3, 0.3 dB/m/kHz

Ref.) Jiang & Chapman (JASA, in press)

MEASUREMENTS VS. SIMULATION



BOTTOM LOSS FOR FIRST TWO LAYERS

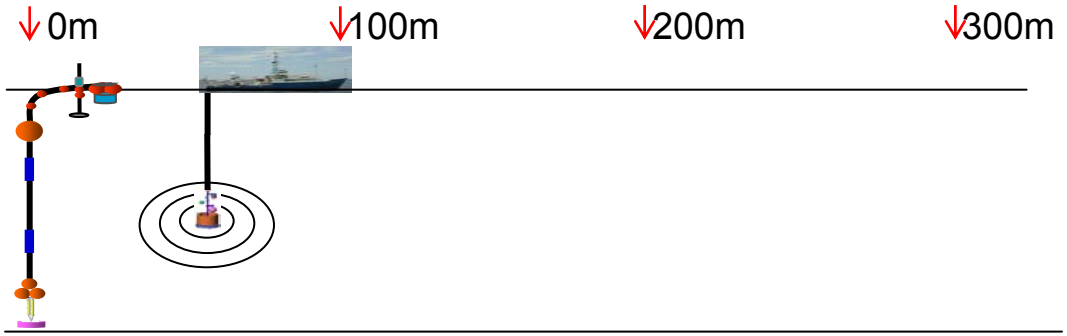


Surficial layer

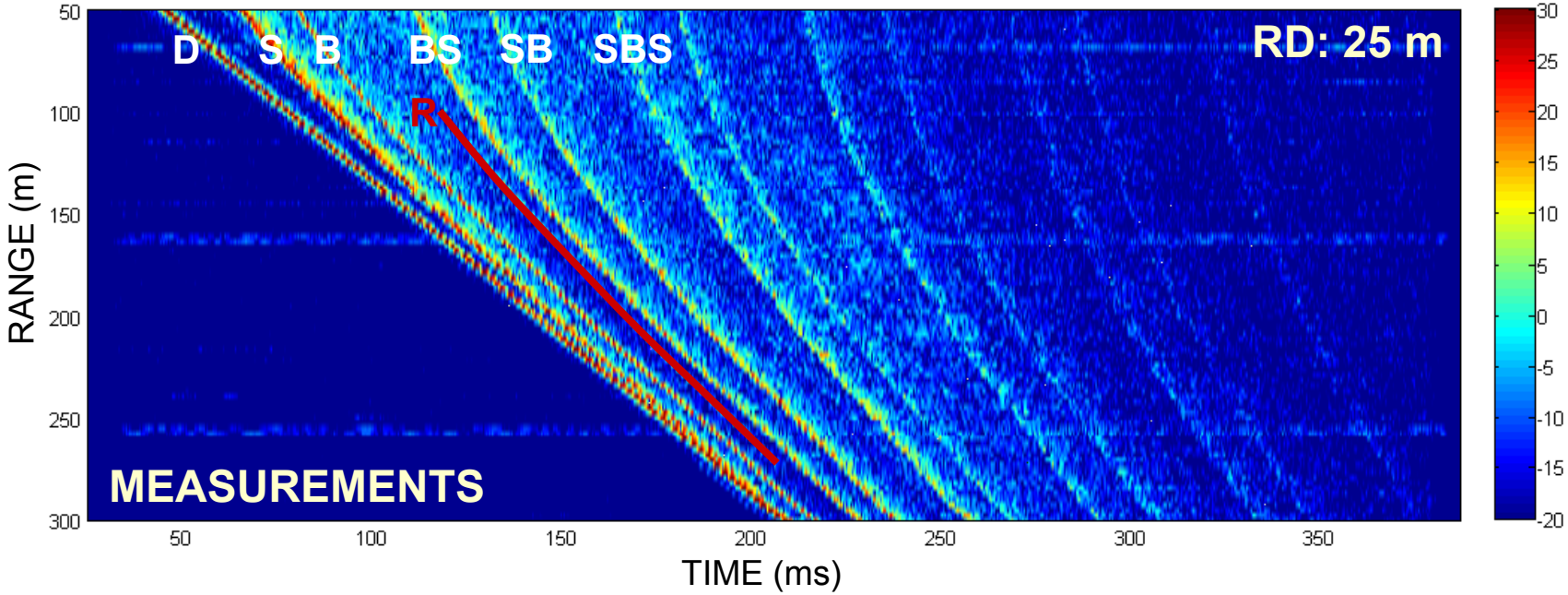
——— 1730 m/s

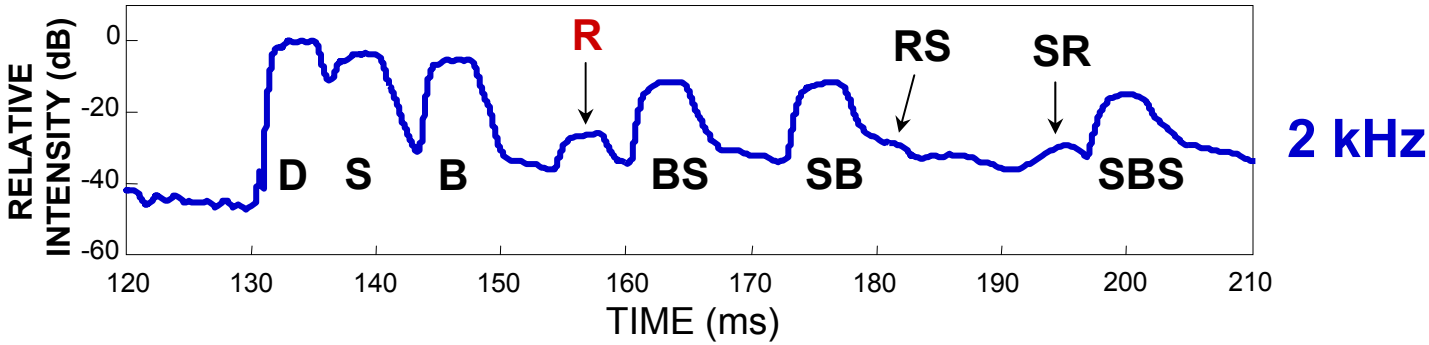
- - - - - 1650-1728 m/s (for 1 – 20 kHz)

$\alpha = 0.2\, f^{1.6}$ dB/m, f: kHz

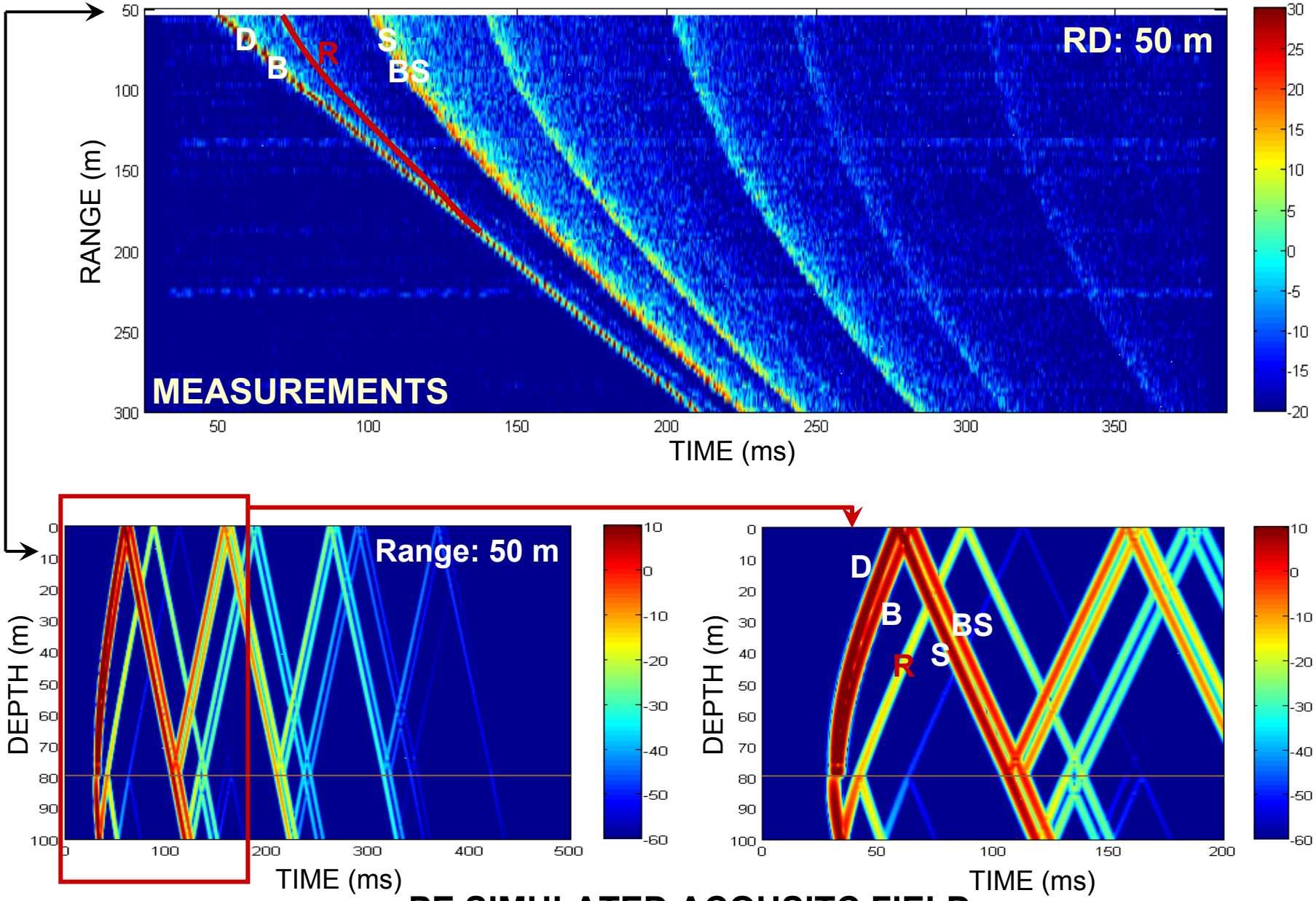


MOVING SOURCE SD: 40 m





MOVING SOURCE SD: 75 m depth



PE SIMULATED ACOUSITC FIELD

SUMMARY

Acoustic bottom-interacting measurements from SW06
in New Jersey Continental Shelf, WD 80 m

(1) Direct measurements of the reflection from the R-reflector
(for < 6 kHz)

(2) Reflection Coeff.(R_{13}) measurements (for 1-20 kHz)

→ ***show a thin (~20 cm) higher sound speed layer overlaying a thicker (~20 m) lower sound speed layer ending at a high-impedance reflector (R-reflector)***


THANK YOU !
감사합니다!(GAM SA HAM NI DA!)