

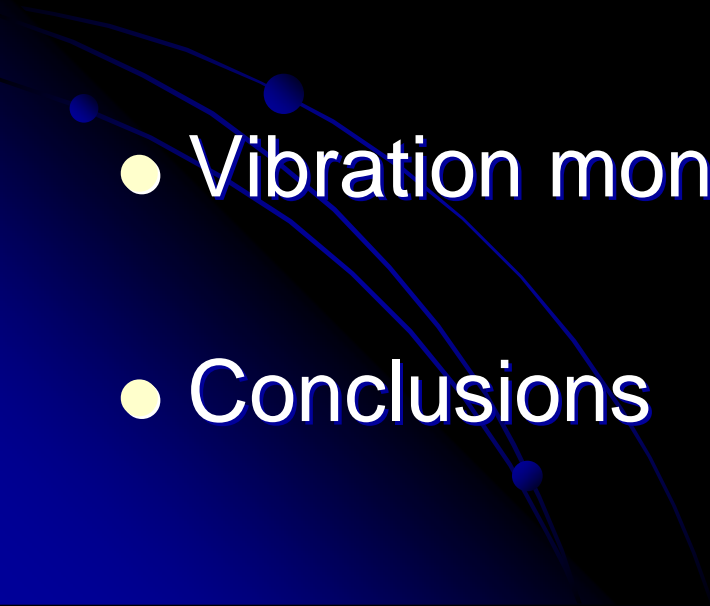
Analysis of co-located pressure and particle velocity measurements

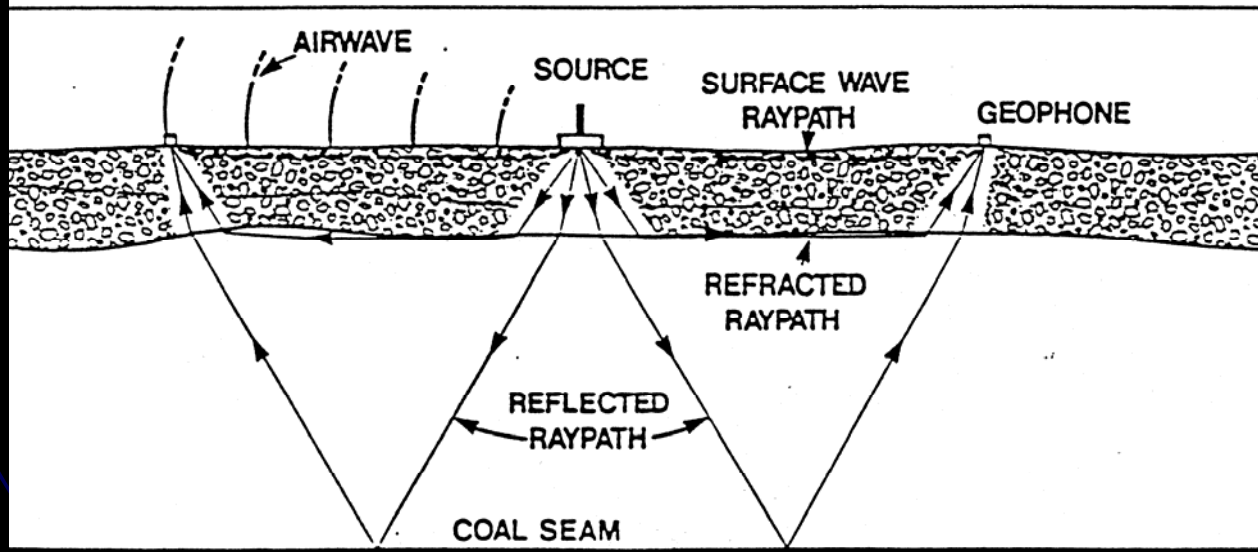
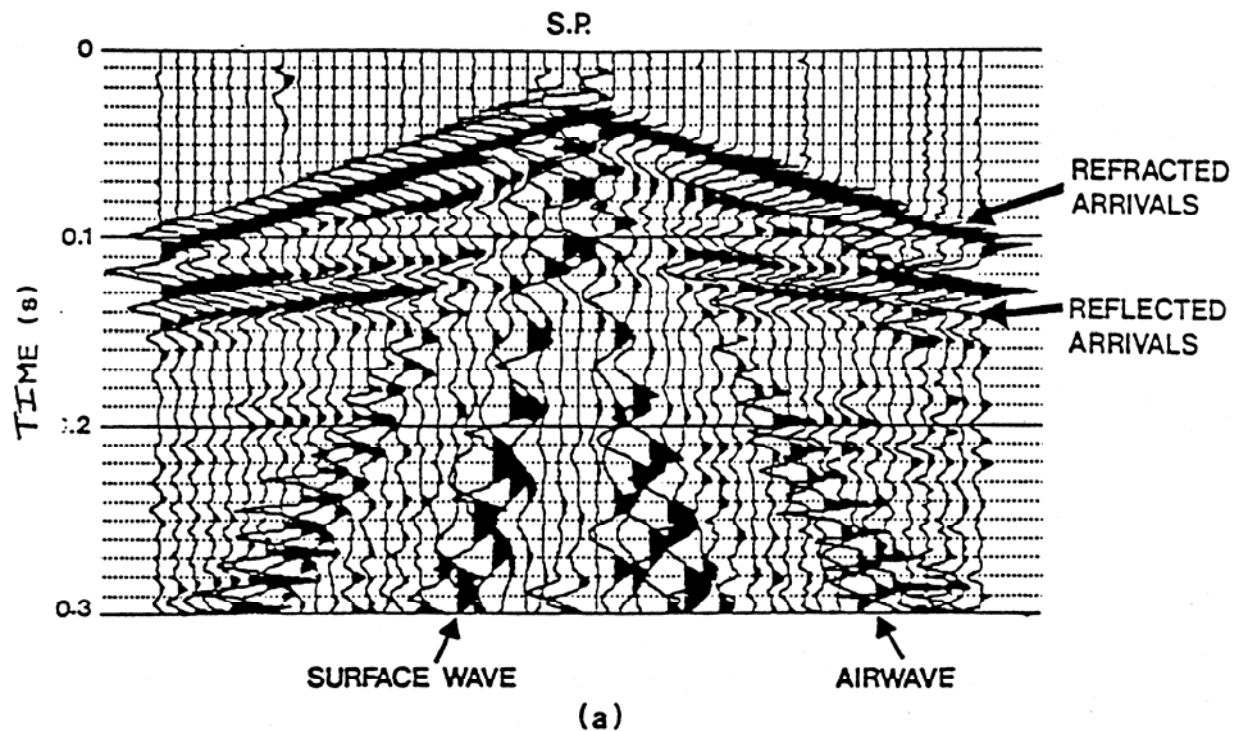
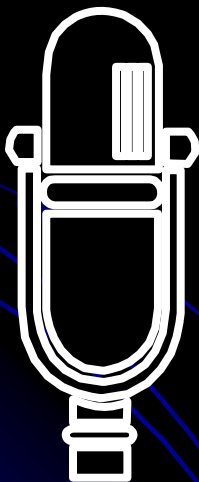
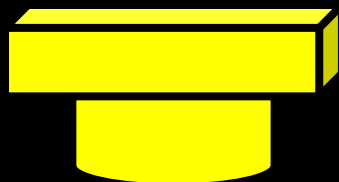
Alejandro D. Alcudia and
Robert R. Stewart

November 29th, 2007



Outline

- Applications
 - Modelling of source-generated airwave
 - Microphones at Pikes Peak oil field
 - Vibration monitoring at Nanton, Alberta
 - Conclusions
- 



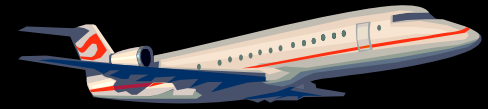
Sound pressure level (dB)



$$P_{\text{total}} - 1 \text{ atm} = \Delta P$$

$$\text{dB} = 20 \cdot \log_{10} \left(\frac{\Delta P}{20 \mu\text{Pa}} \right)$$

140
130
120
110
100
90
80
70
60
50
40
30
20
10
00

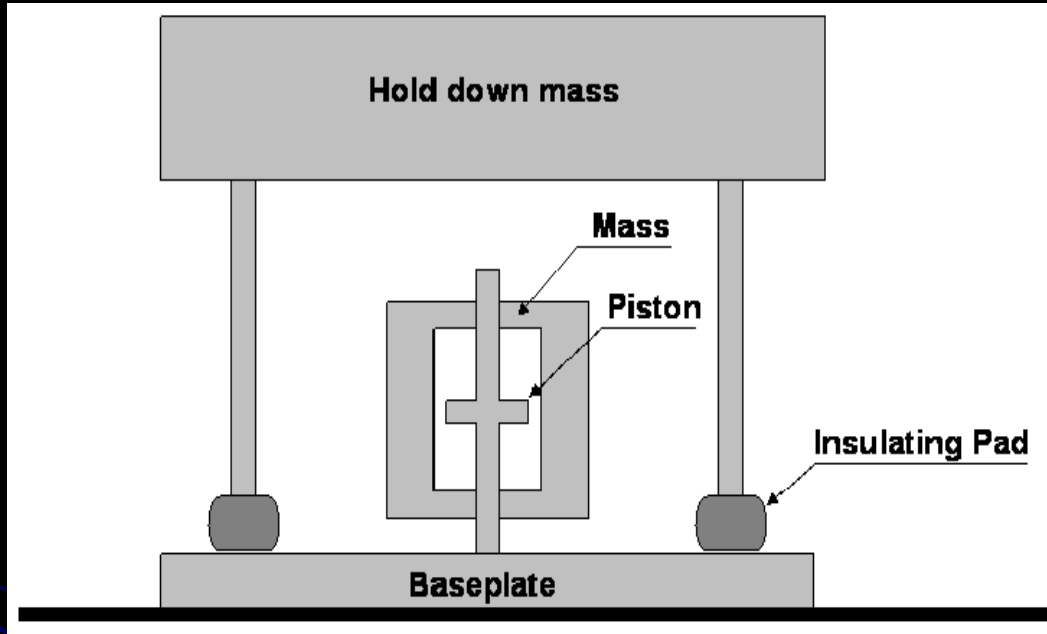


Threshold of pain

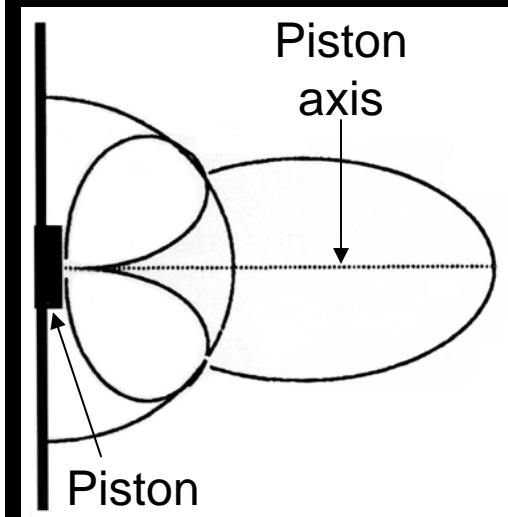


Threshold of human hearing

Acoustic source modelling

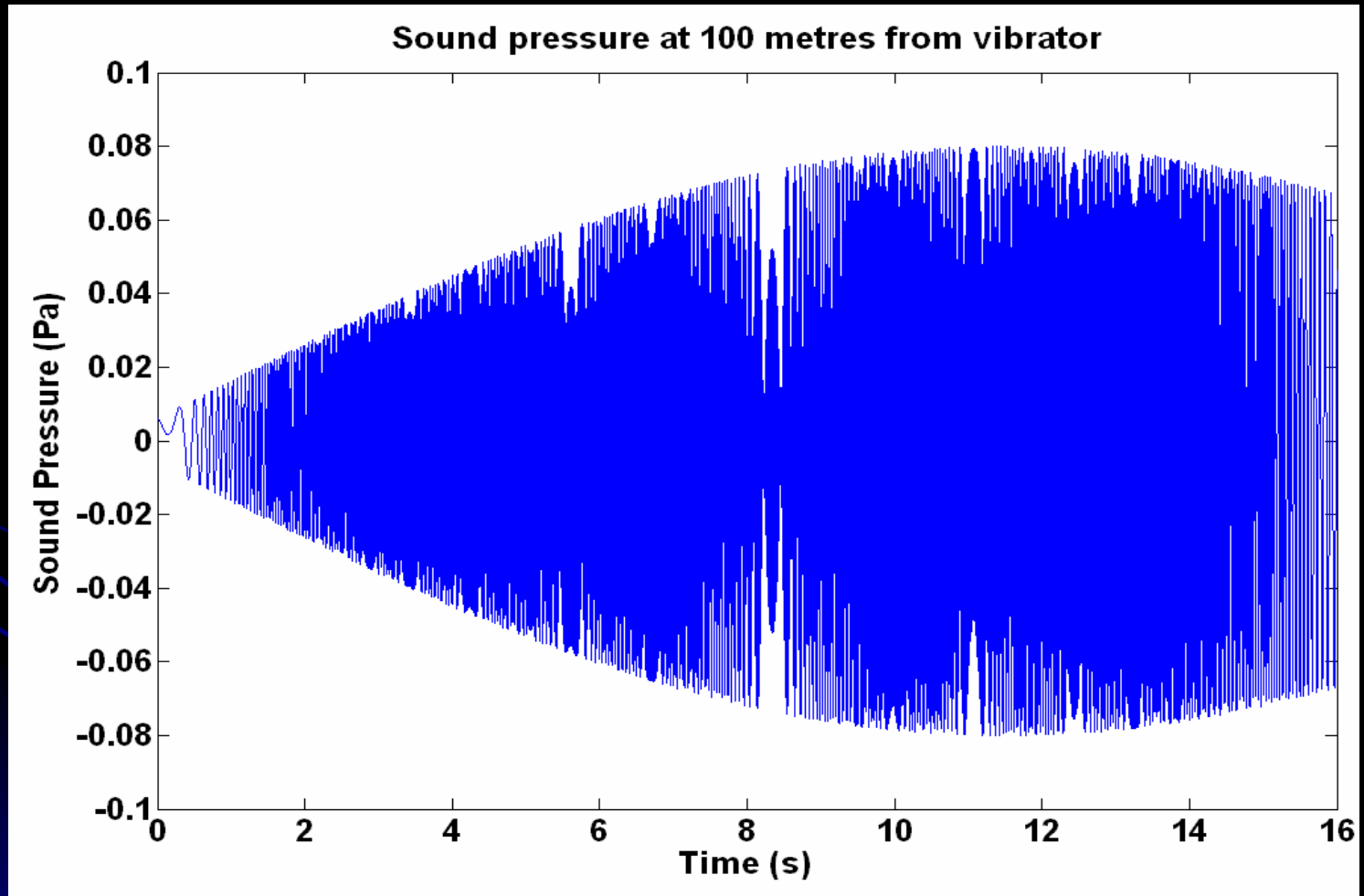


Vibrator's baseplate
behaves as a
big loudspeaker



Circular piston
vibrating in an
infinite baffle
of radius r

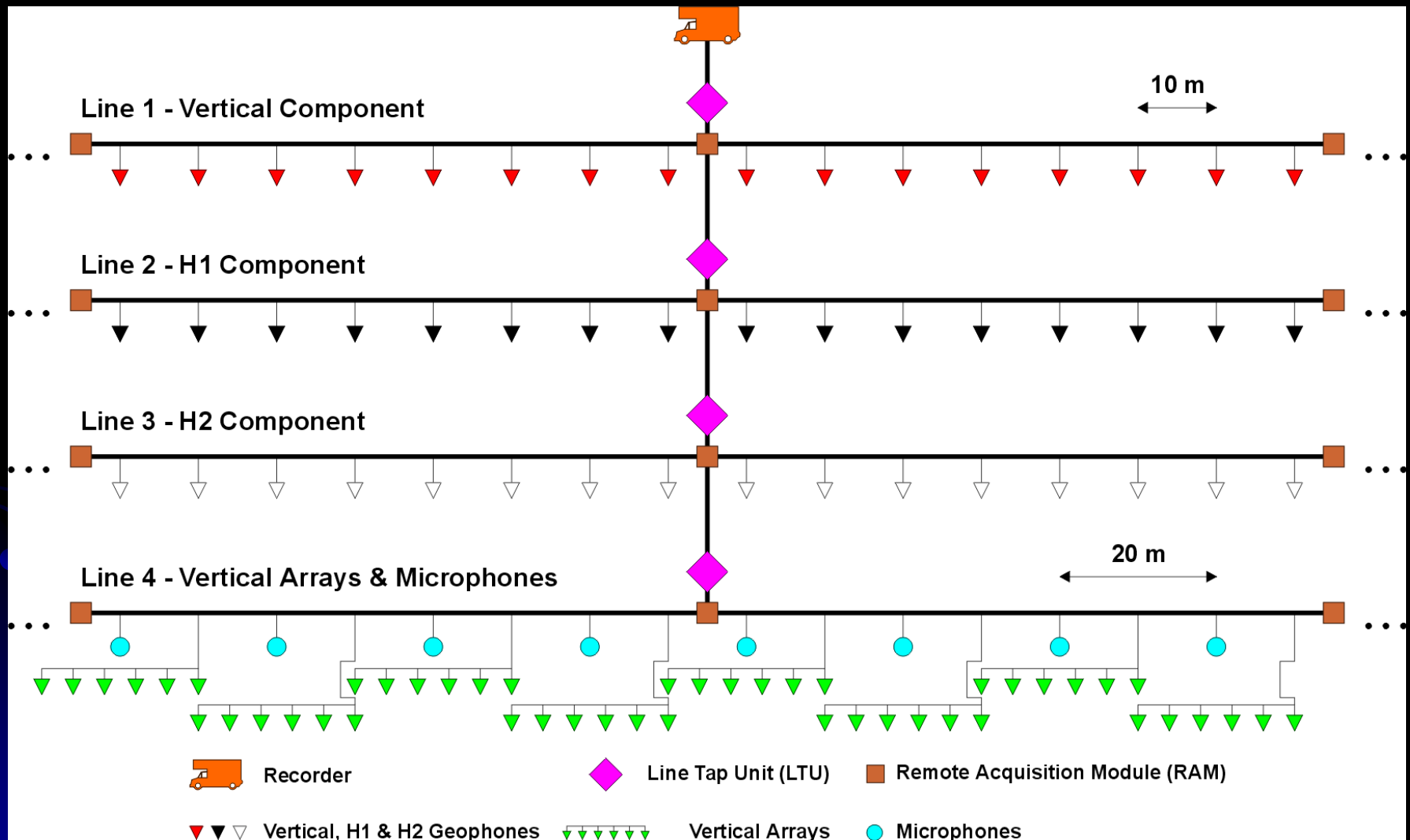
Sound pressure simulation



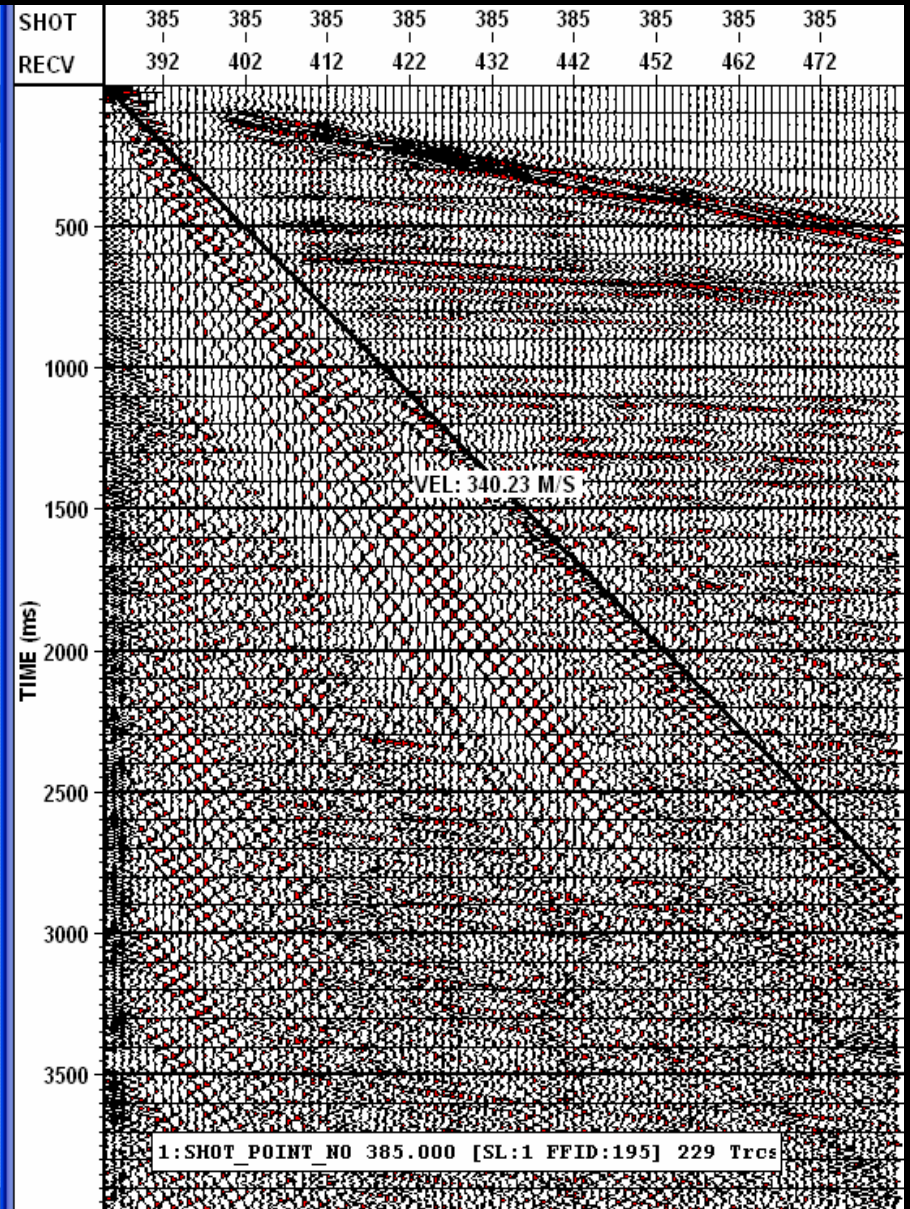
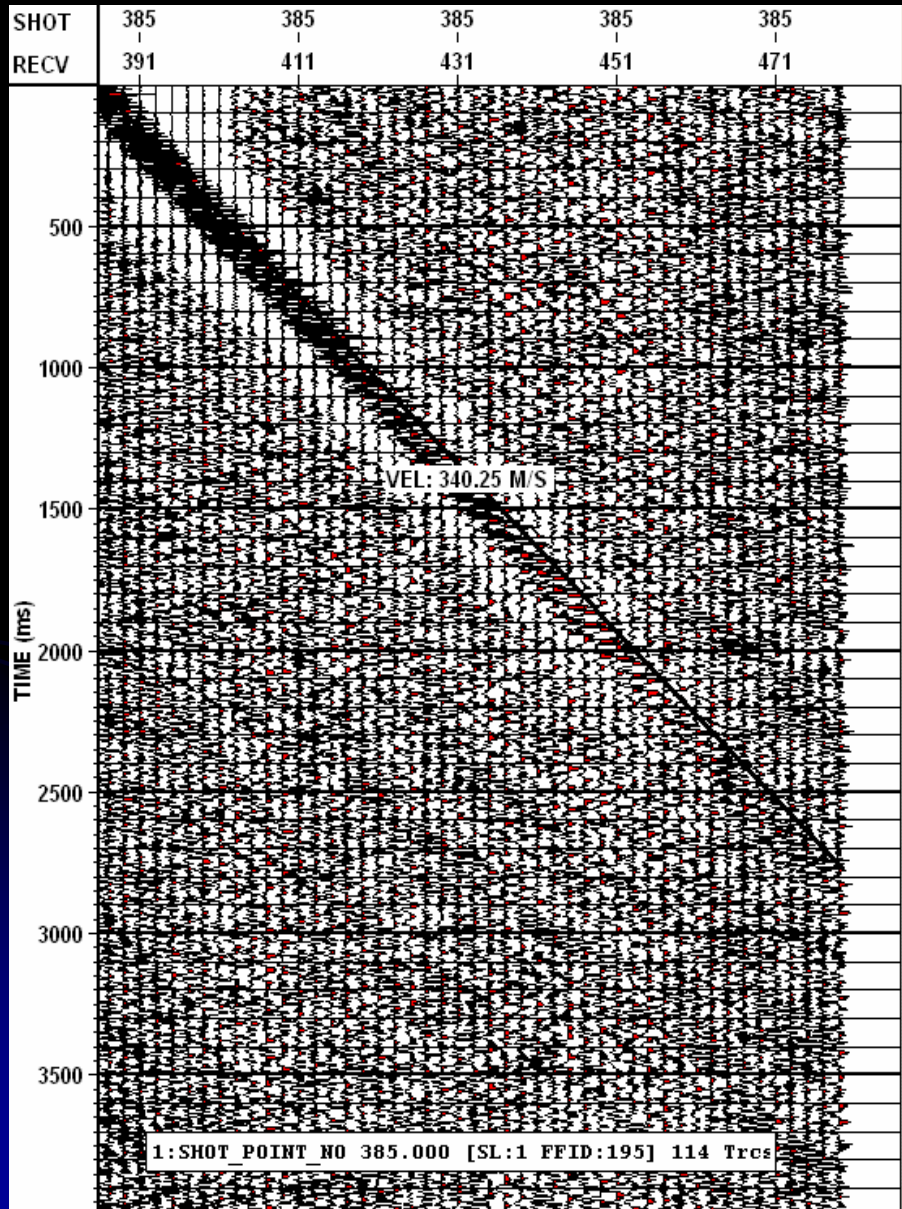
Experiment at Pikes Peak oil field

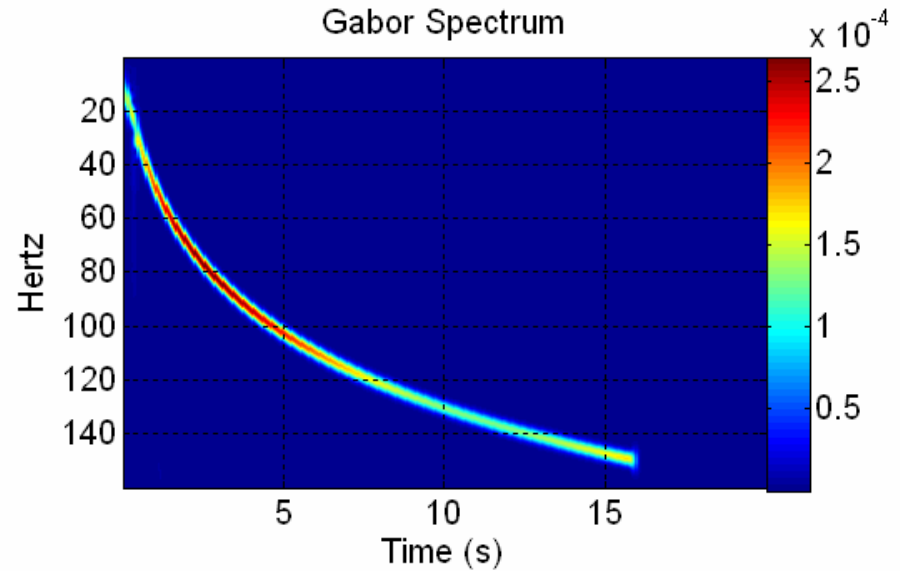
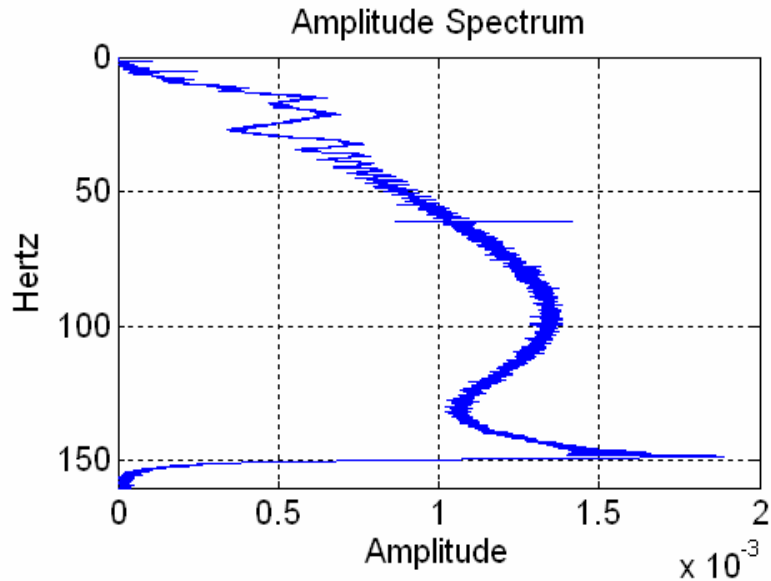


Pikes Peak 3-C 2-D field layout

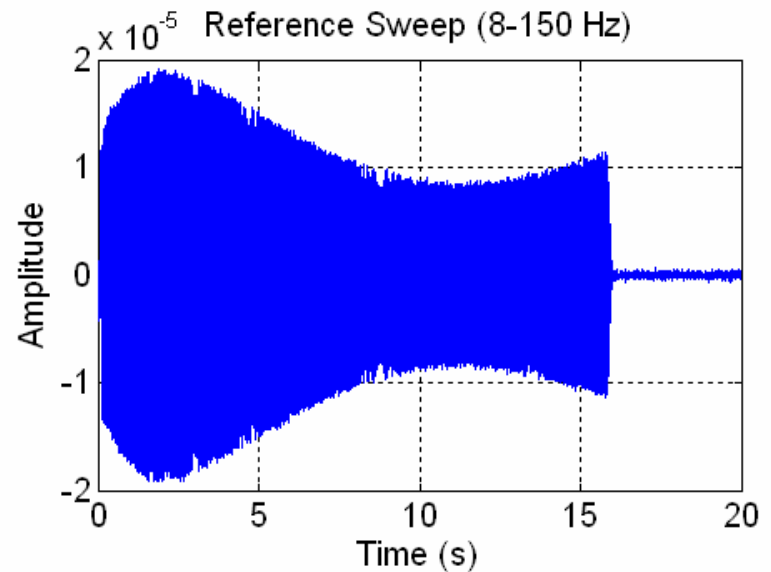


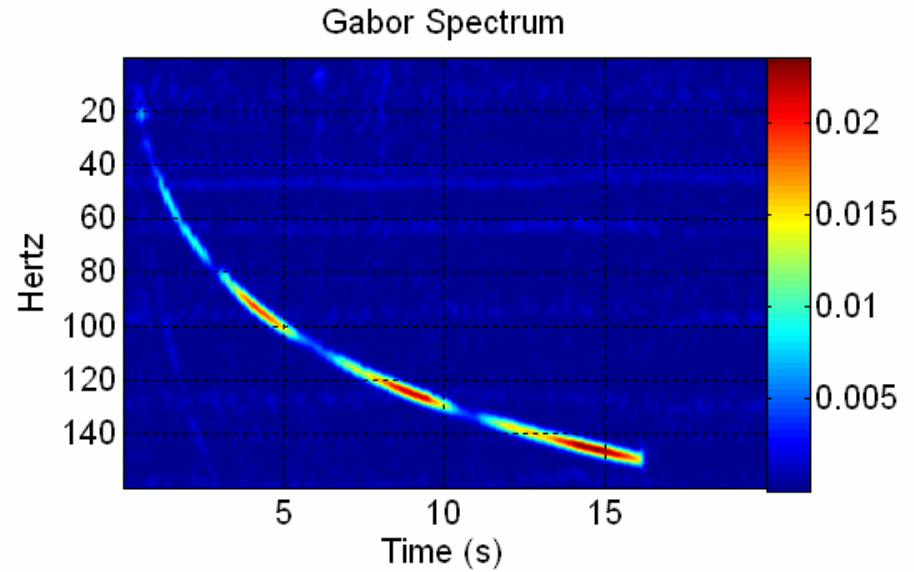
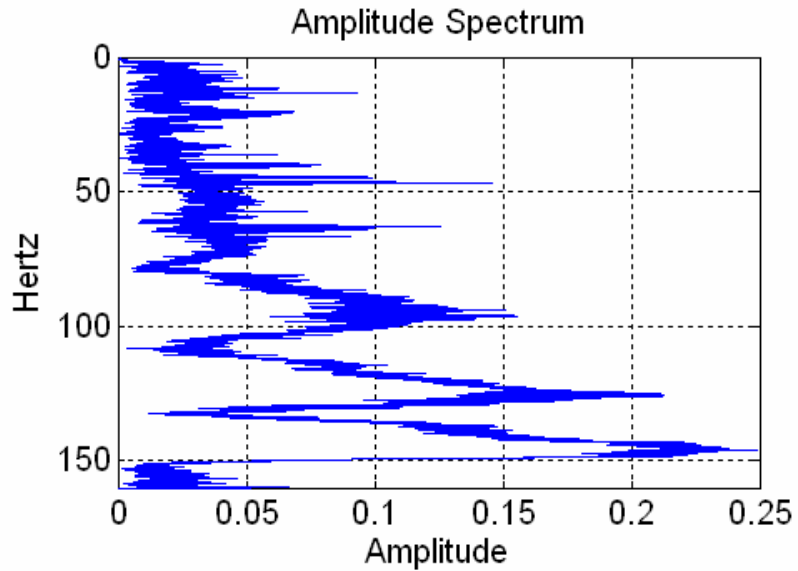
Shot gather – Microphone vs Vertical



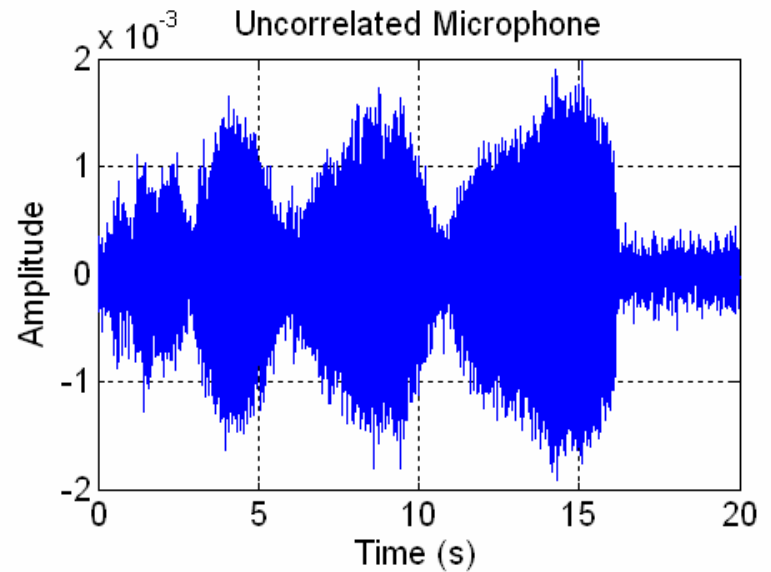


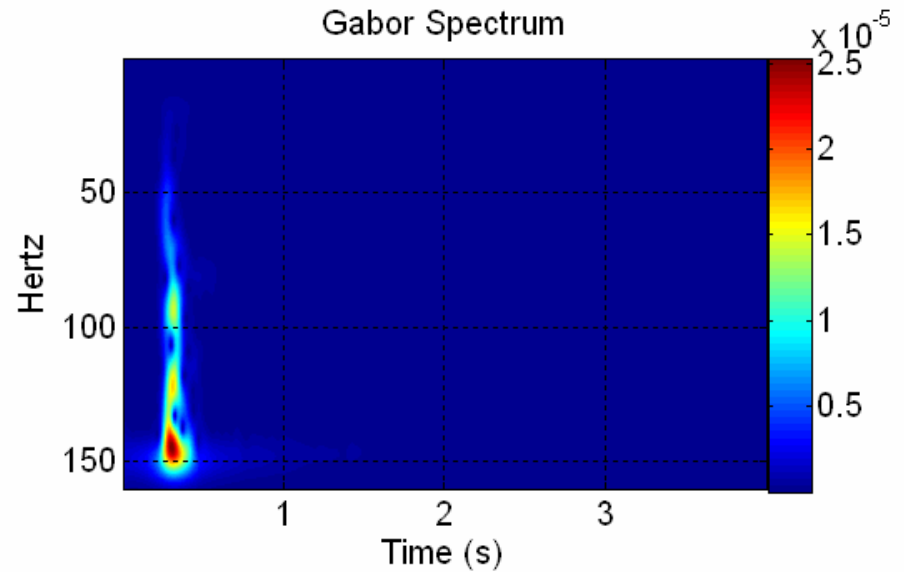
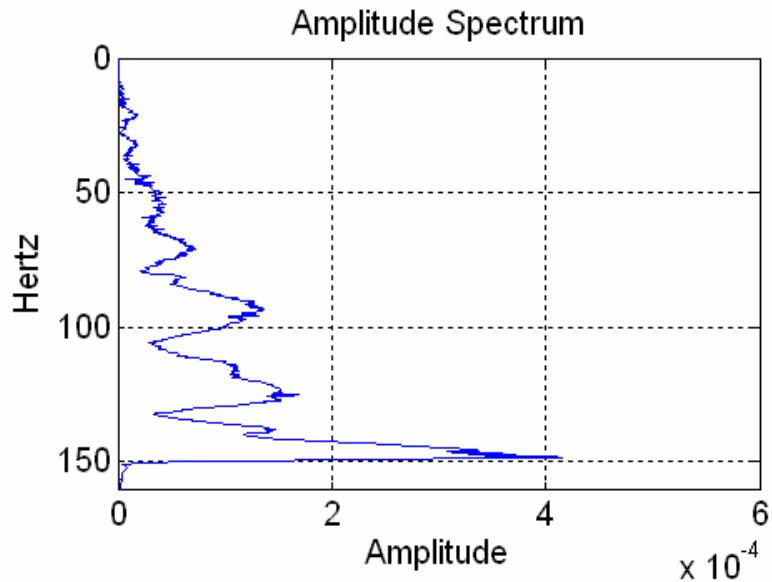
- Linear sweep 8-25 Hz
- Non-linear sweep 25 – 150 Hz
- 16 s length
- 4 s listening



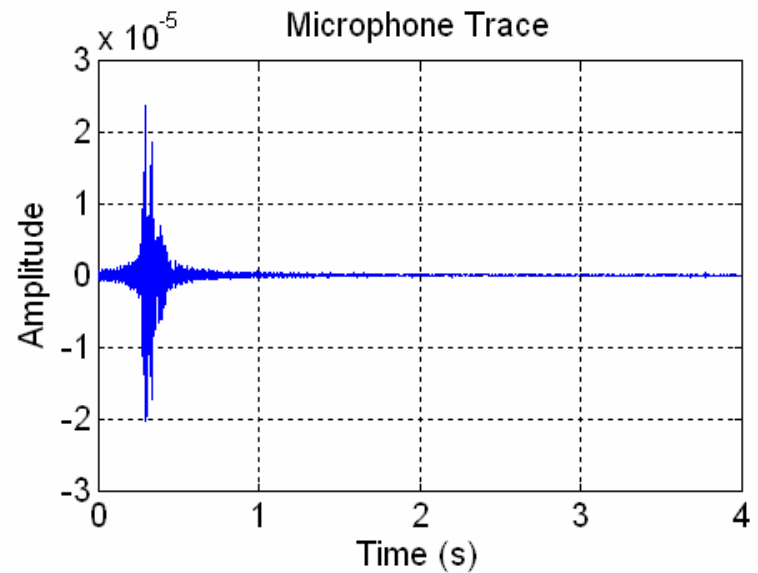


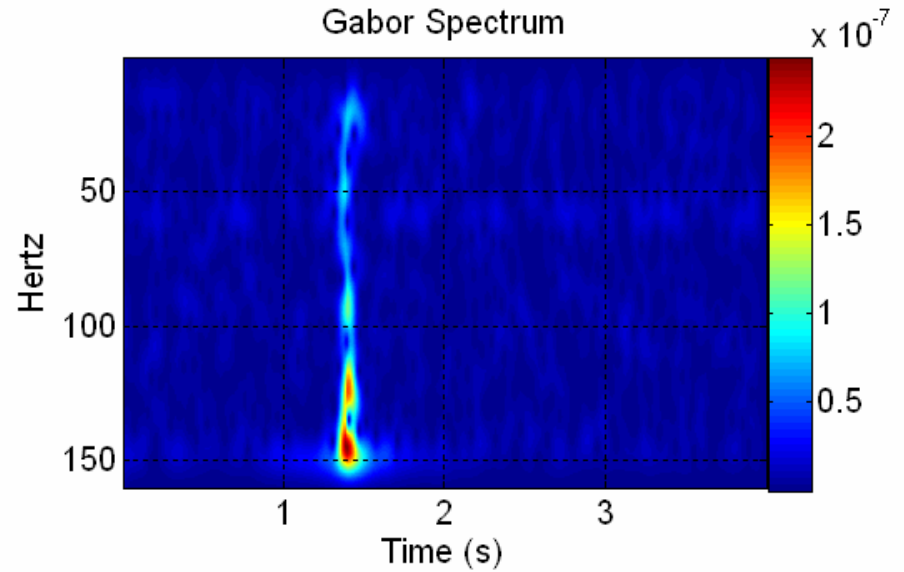
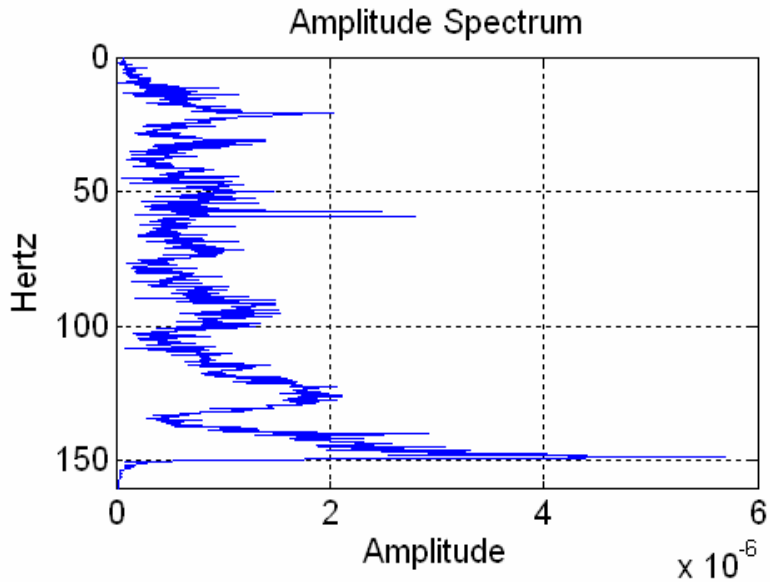
- Microphone
100 m offset



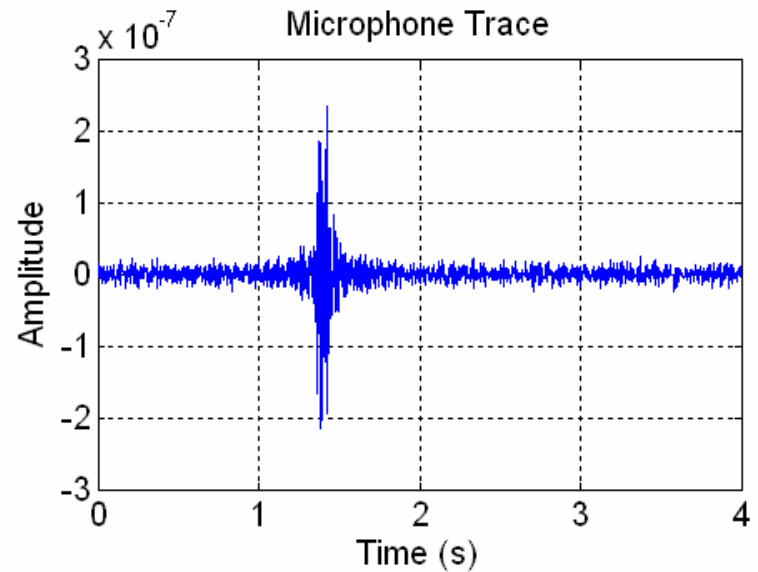


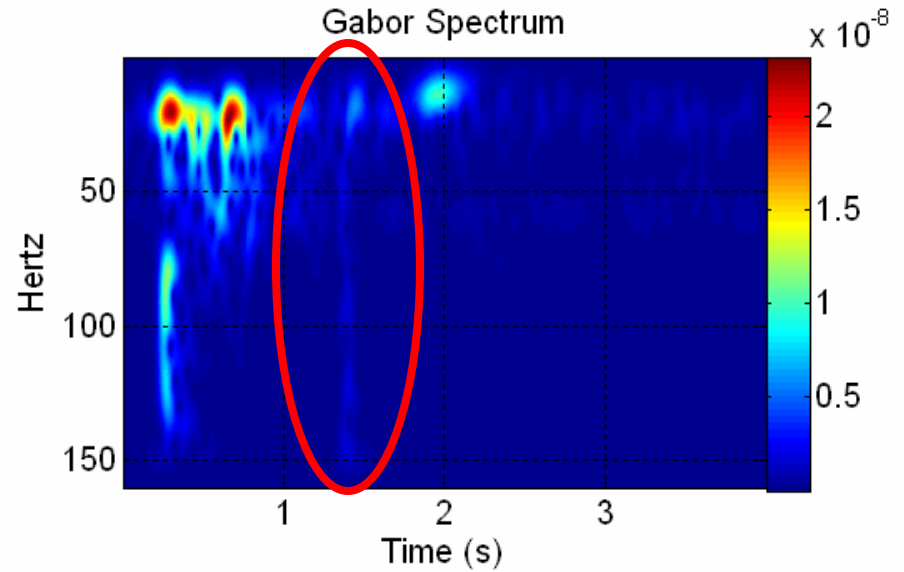
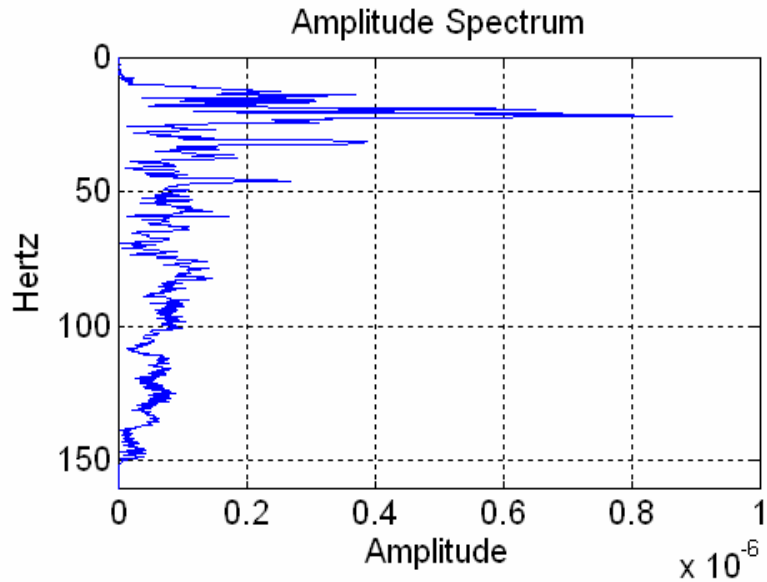
- Correlated microphone
100 m offset



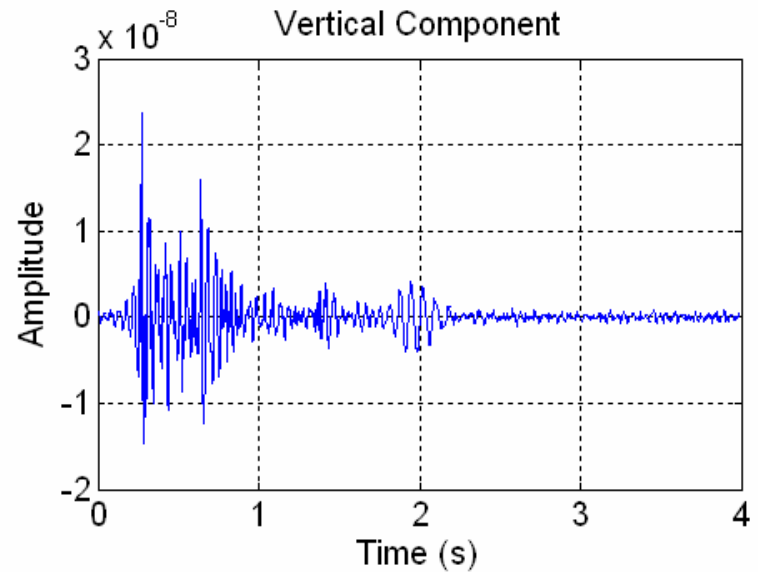


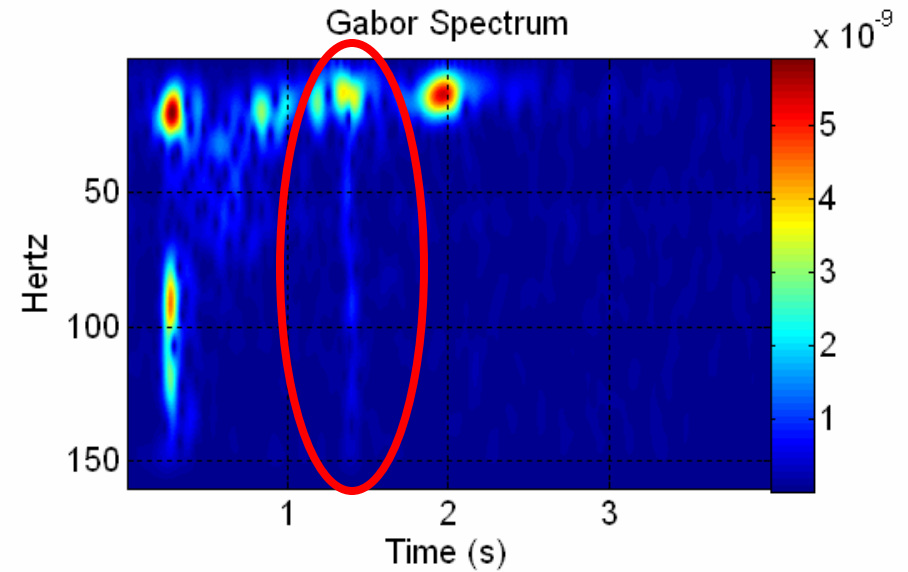
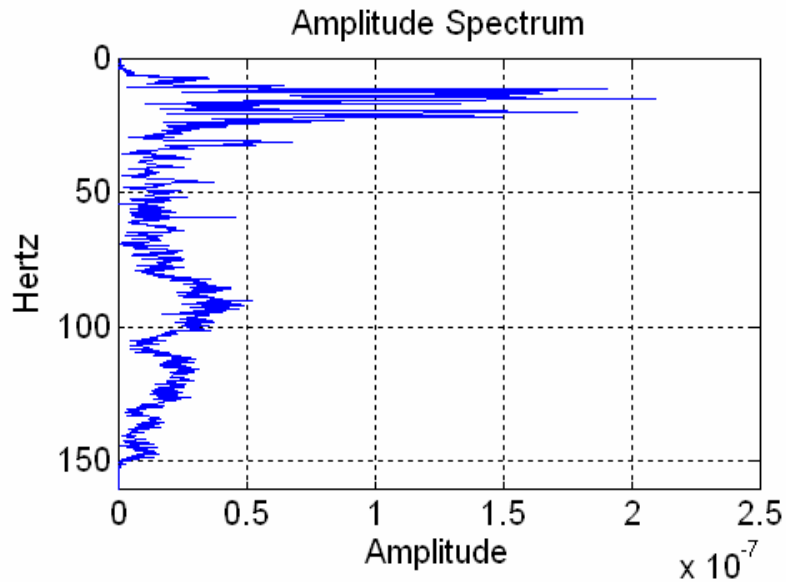
- Correlated microphone
460 m offset



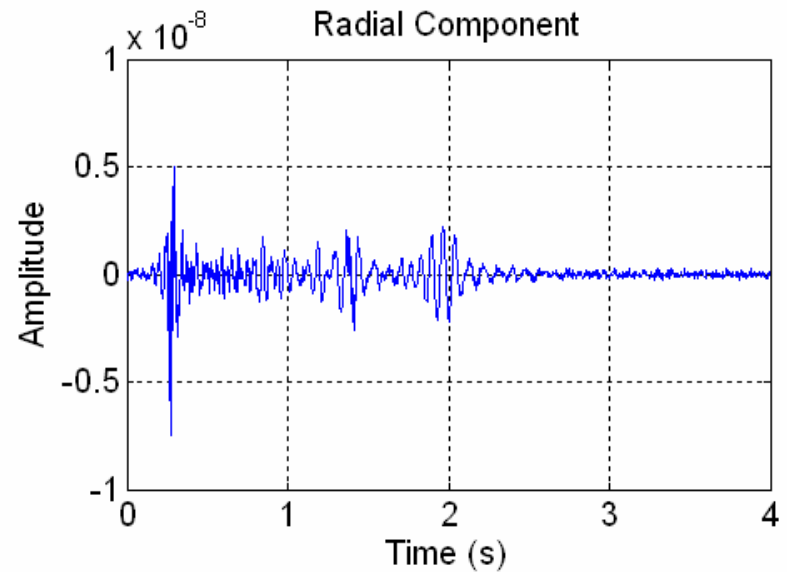


- Vertical geophone
460 m offset





- Horizontal geophone
460 m offset



Vibration monitoring at Nanton, Alberta



- Protecting water springs
- Dynamite and vibroseis sources
- Peak particle velocity (PPV) and peak over-pressure (PSPL)

Stand-off distance (m)

Canada Oil and Gas Geophysical Operations Regulations (SOR/96-117)

Stand-off distance

Facility

dynamite < 2 kg

2 kg < dynamite < 4kg

Vibroiseis

Dam

64 m

90 m

100 m

Oil or gas well

32 m

45 m

15 m

Pipeline

32 m

45 m

15 m

Structure with concrete base

64 m

90 m

50 m

Residence

64 m

90 m

50 m

Area of public congregation

64 m

90 m

50 m

Water well

64 m

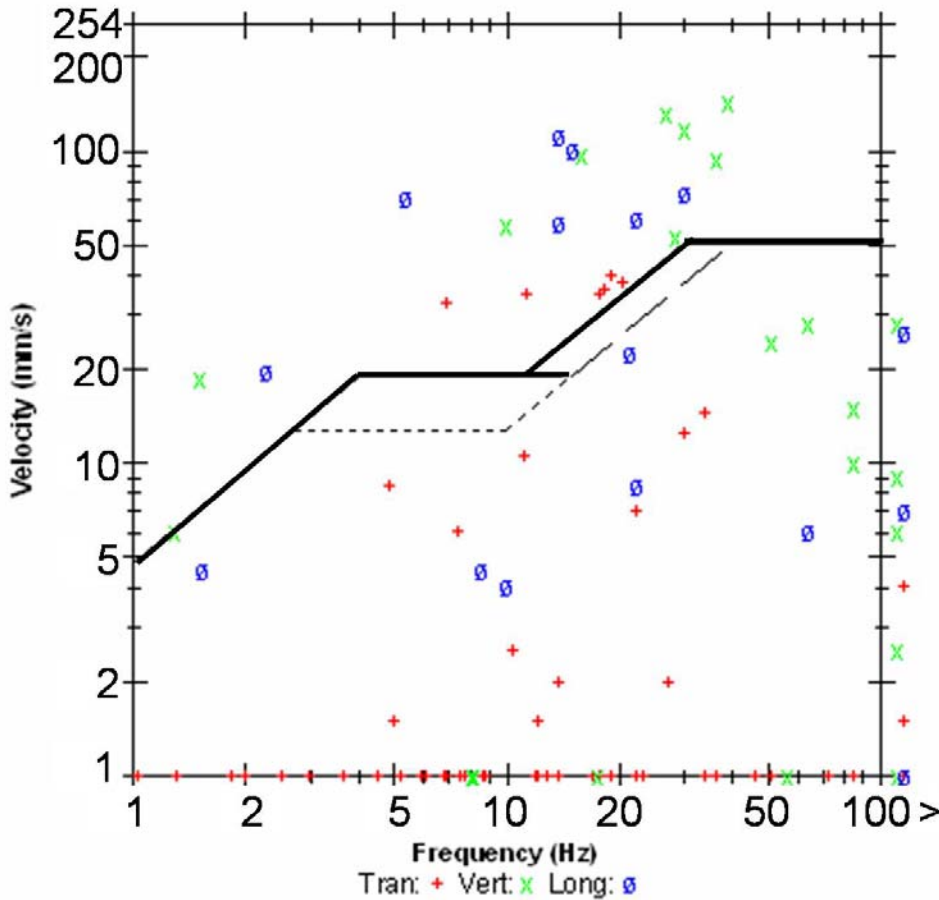
90 m

100 m

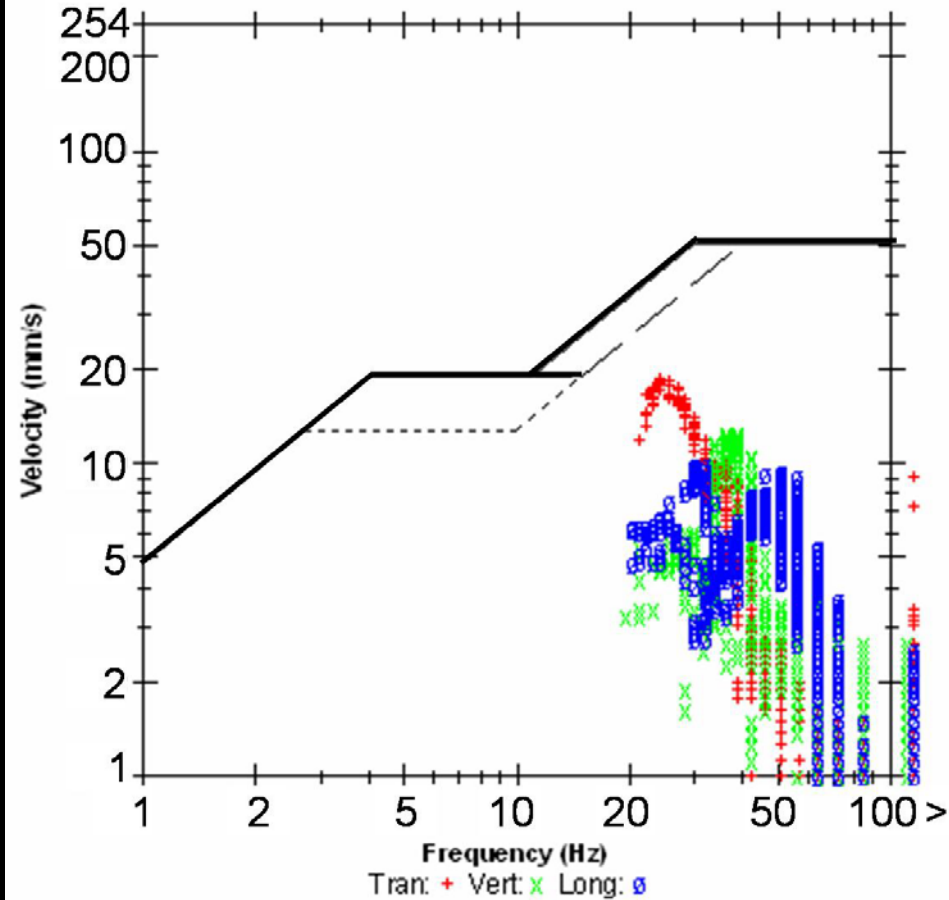
- Dynamite 5m offset
 - PPV = 113 mm/s
 - PPV = 145 mm/s
 - PPV = 40.1 mm/s

- Vibroseis 5m offset
 - PPV = 12.7 mm/s
 - PPV = 10 mm/s
 - PPV = 18.8 mm/s

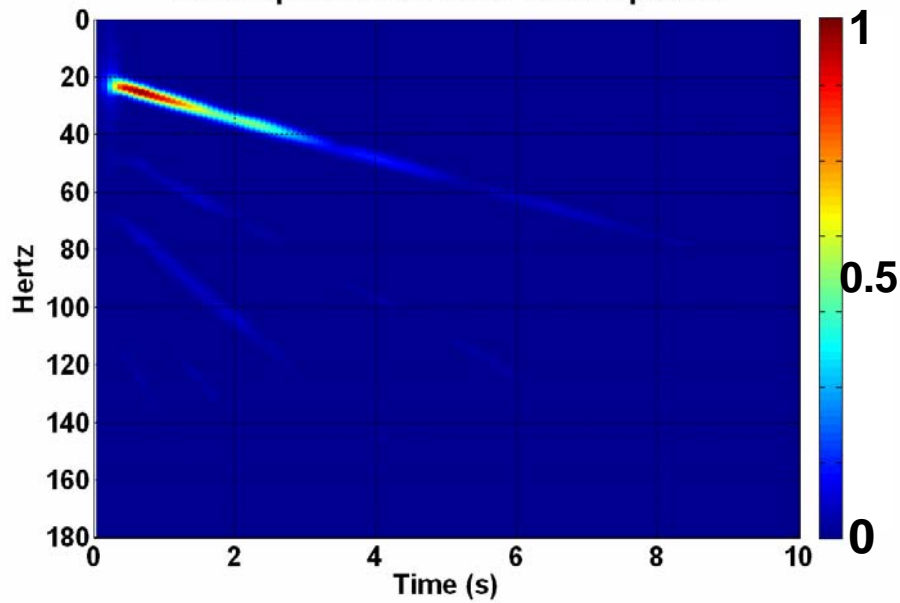
USBM RI8507 And OSMRE



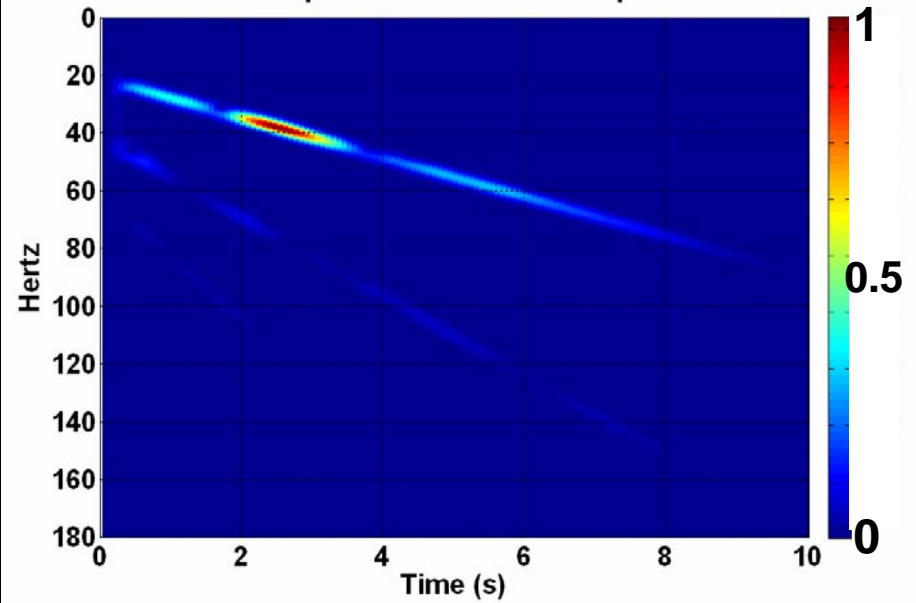
USBM RI8507 And OSMRE



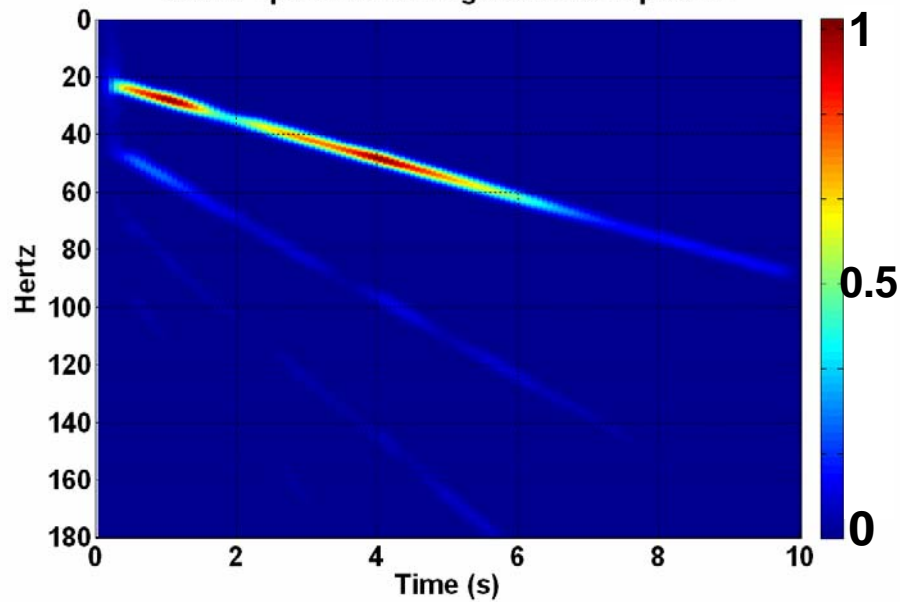
Gabor spectrum of transverse component



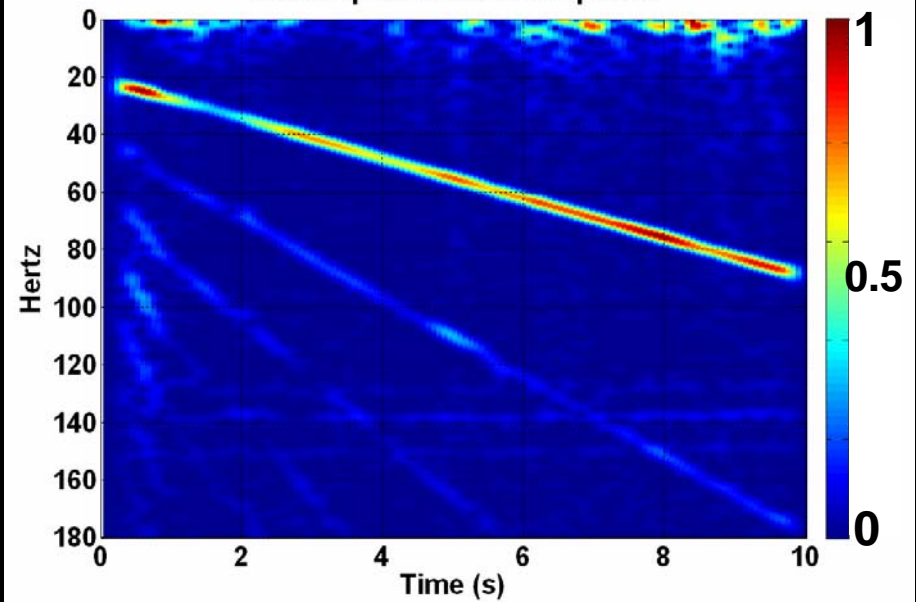
Gabor spectrum of vertical component



Gabor spectrum of longitudinal component



Gabor spectrum of microphone



Conclusions

- Airblast frequencies are affected by the sound radiation pattern
- Airwave coupling is broadband. Stronger at low frequencies.
- Lobes of radiated sound might impact the frequency content of the coupled airwave.
- Measure three components for true PPV

Acknowledgements

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