Acquiring Physically-Modeled Data For VVAZ/AVAZ Analysis

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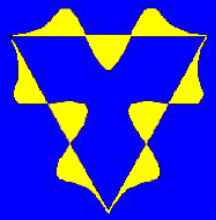
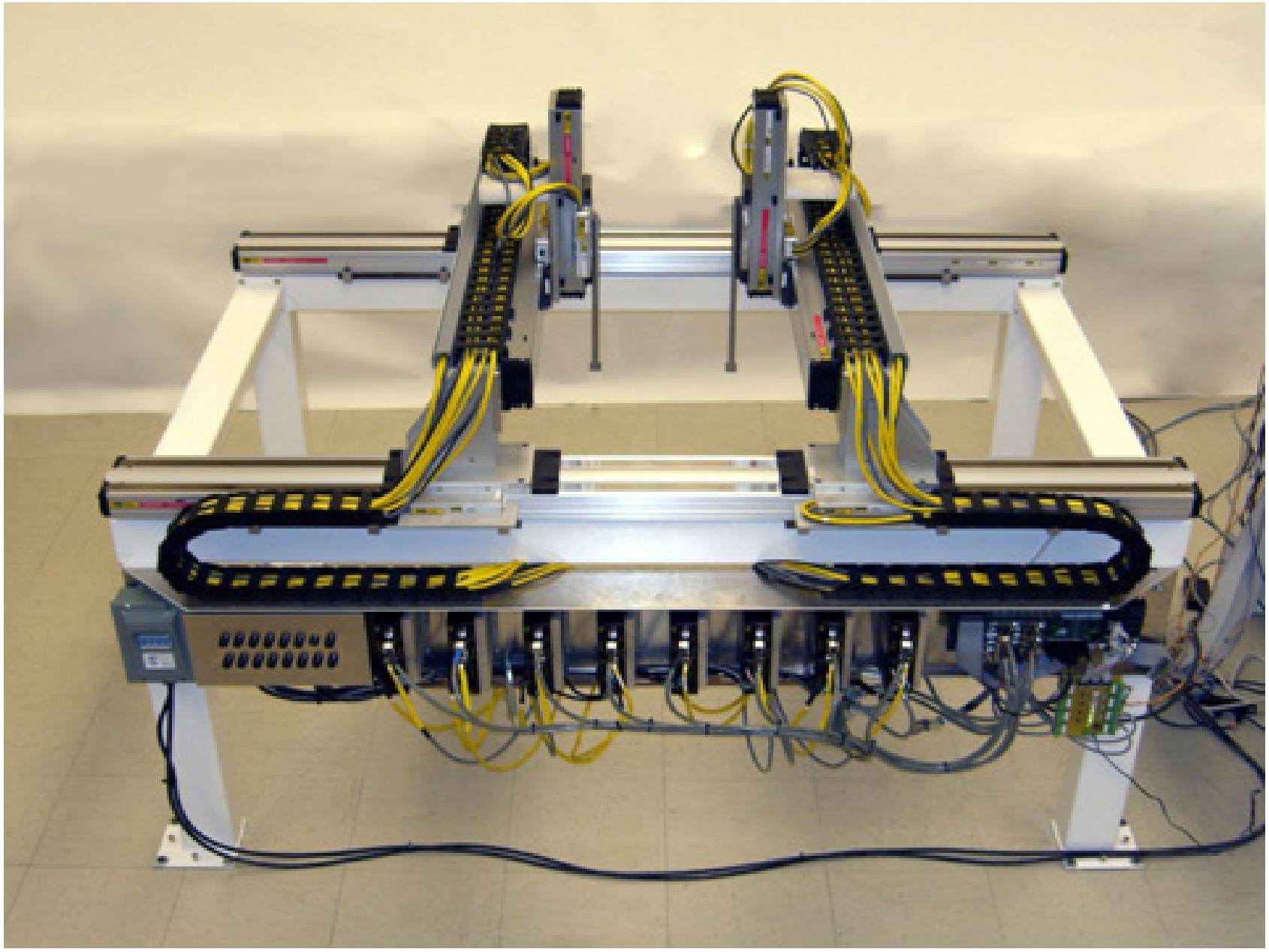
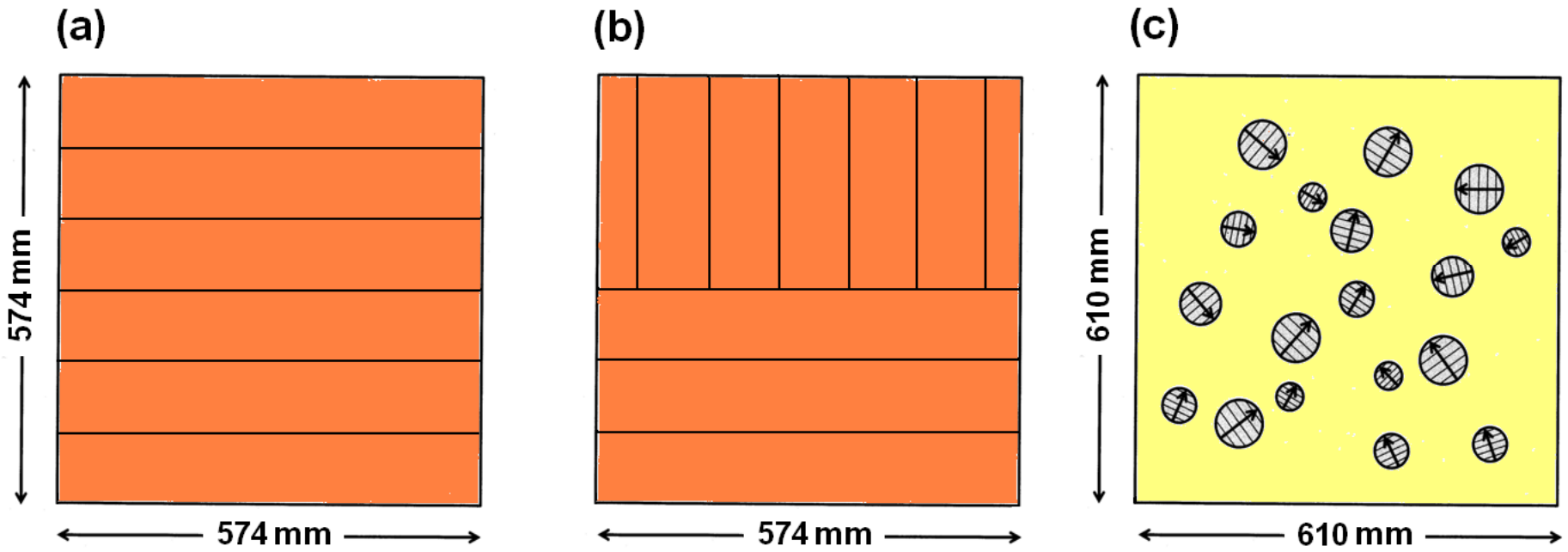


CREWES



Fabricated Anisotropic Solids



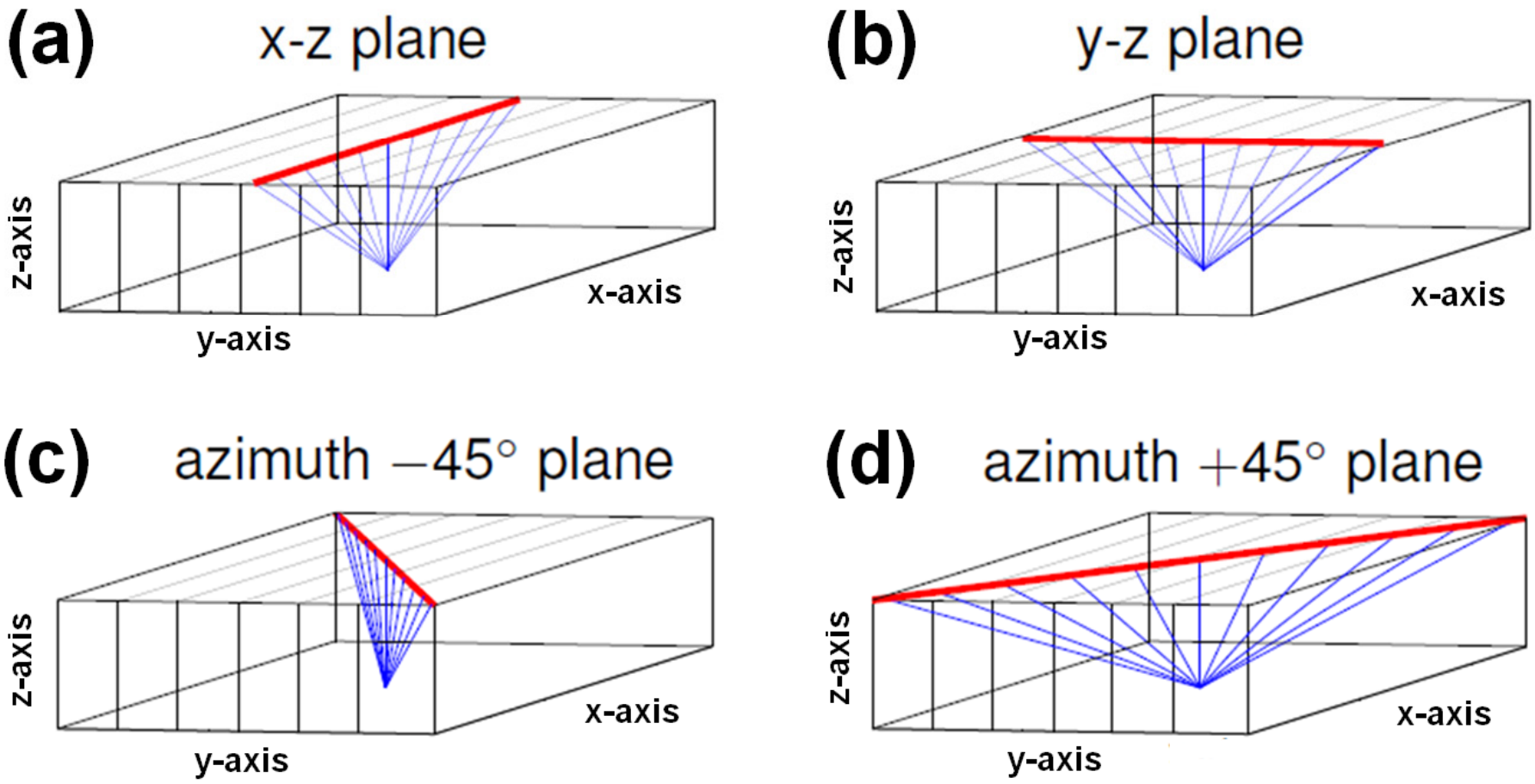
(a) Homogeneous Orthorhombic Phenolic slab.

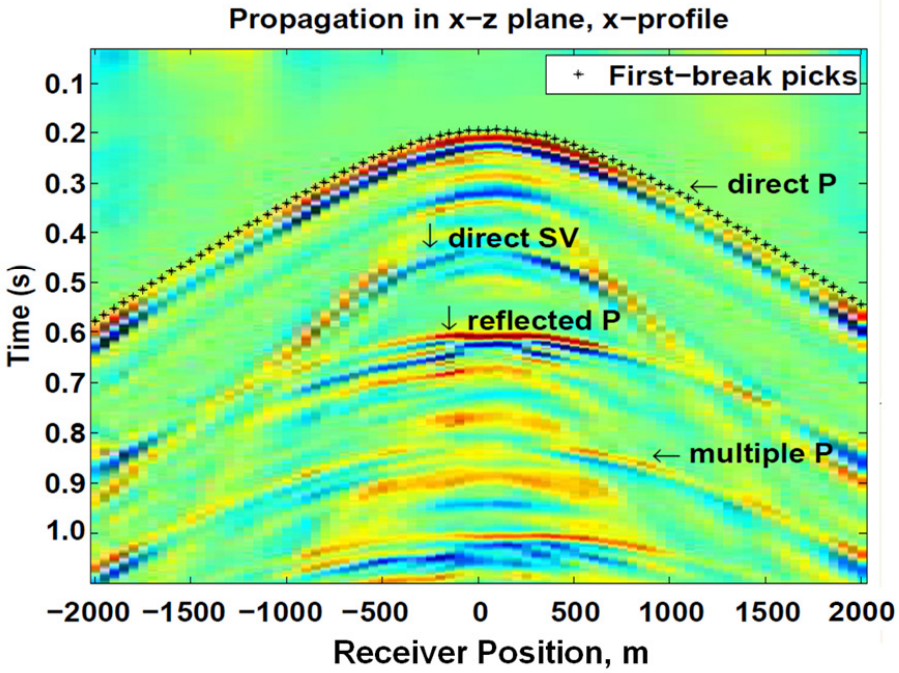
(b) Inhomogeneous Orthorhombic Phenolic slab.

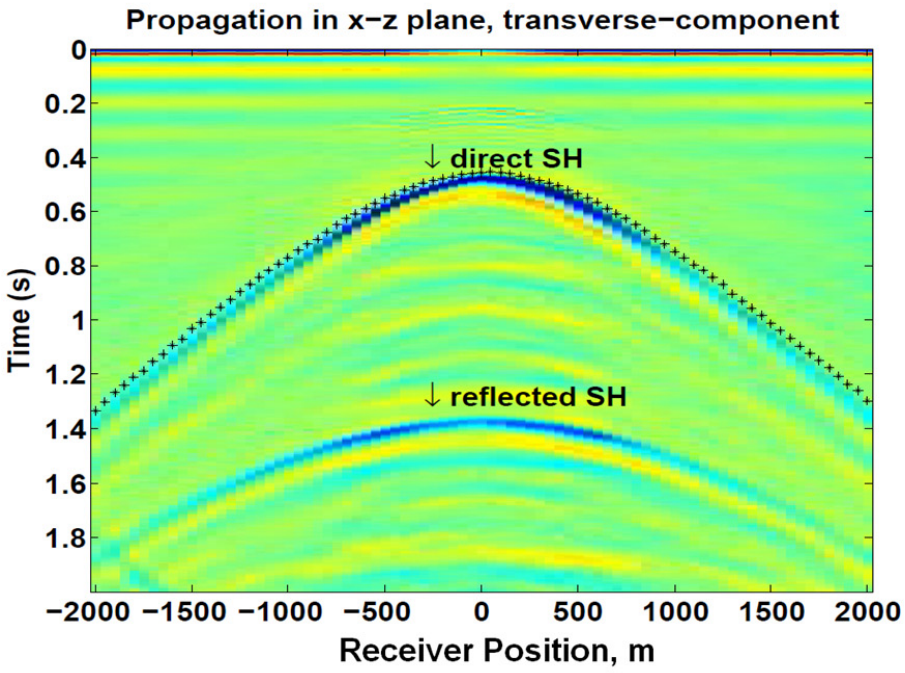
(c) Phenolic pucks embedded in isotropic Acrylic slab.

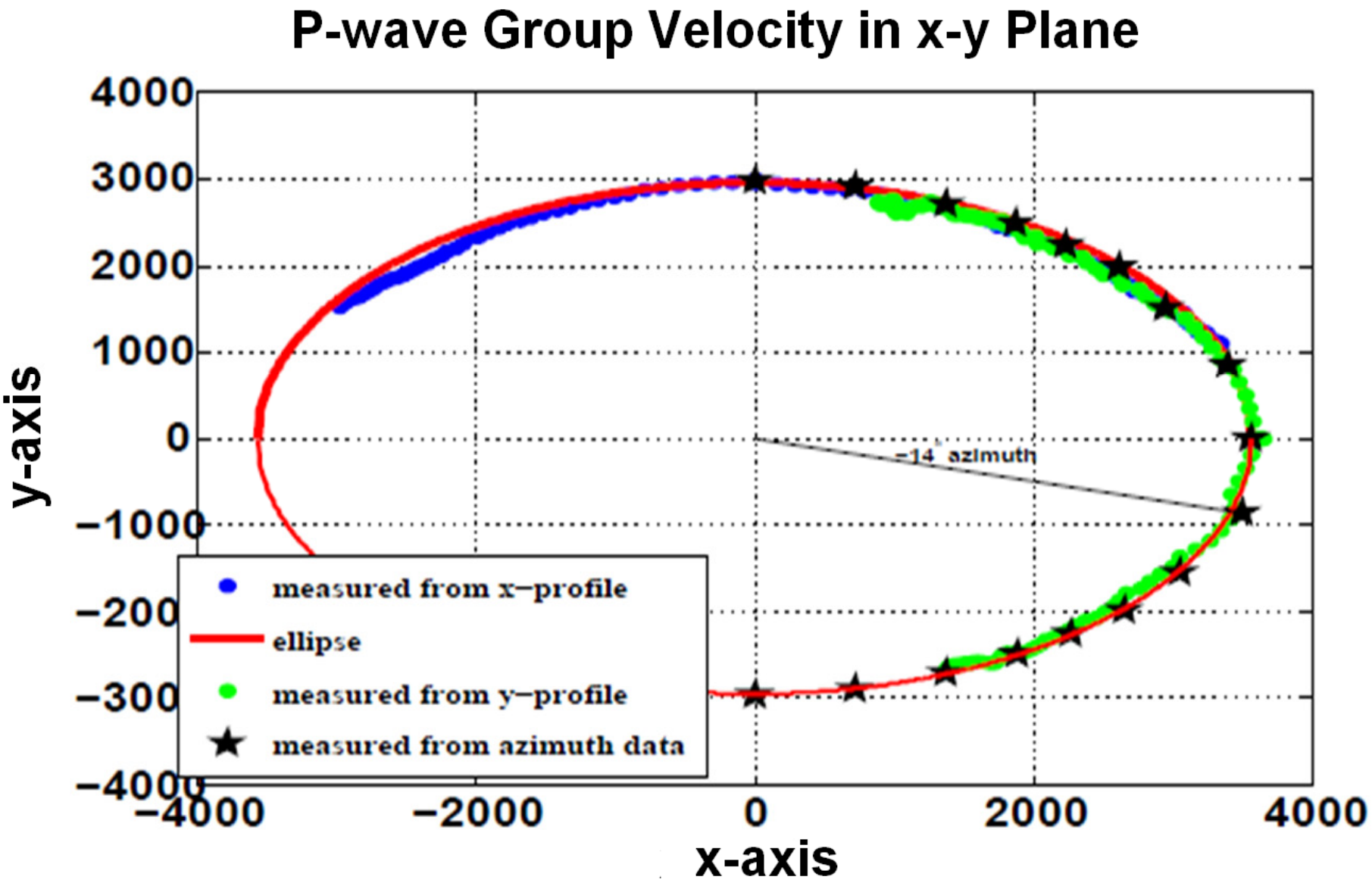
Data for VVAZ Analysis.

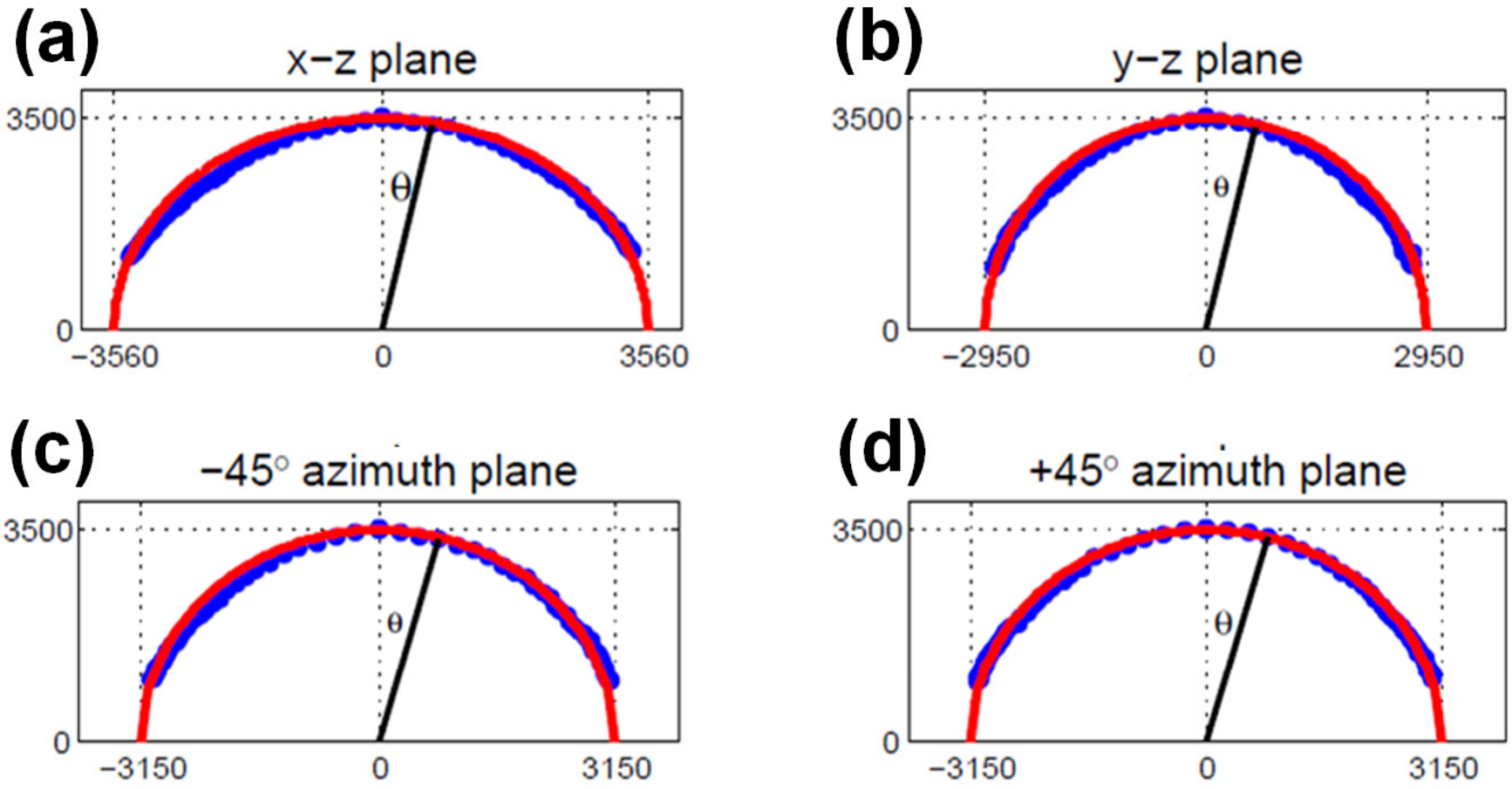
Mahmoudian et al., 2010, CREWES Report 22, 60.1-60.23.


(a)
x-z plane
z-axis
x-axis
y-axis
(b)
y-z plane
z-axis
x-axis
y-axis
(c)
azimuth −45° plane
z-axis
x-axis
y-axis
(d)
azimuth +45° plane
z-axis
x-axis
y-axis

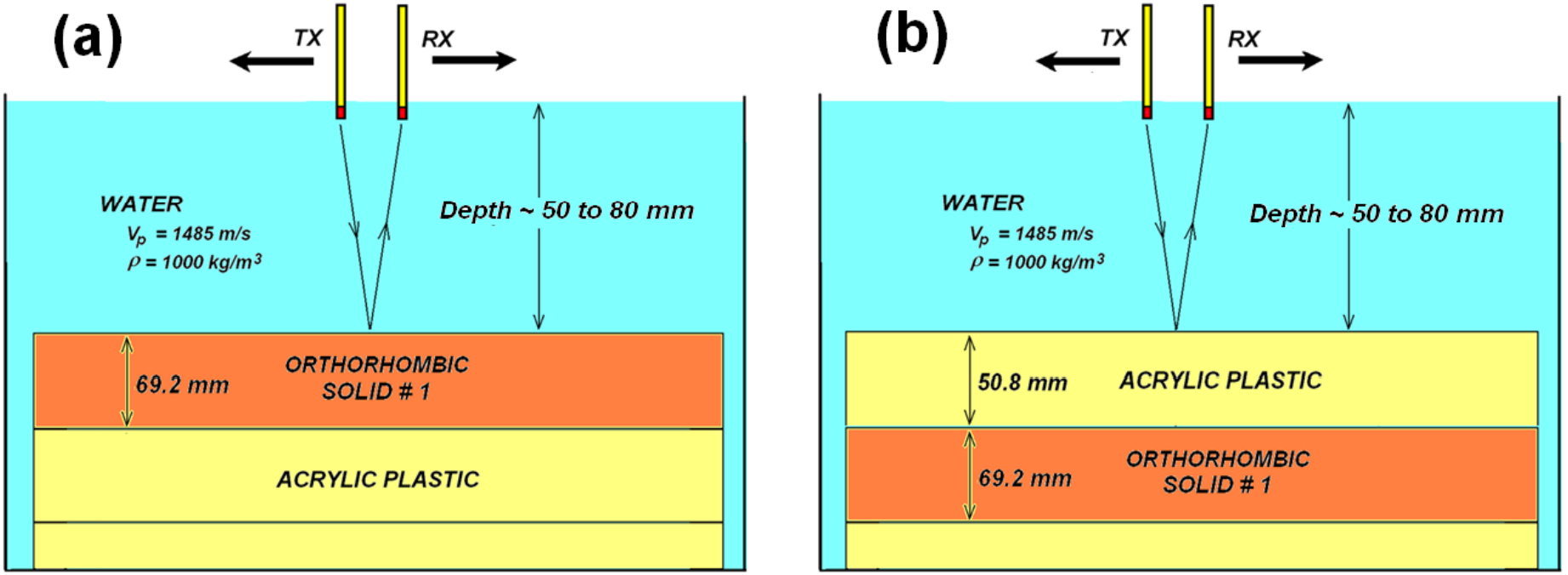

Propagation in x−z plane, x−profile
First−break picks
direct P
direct SV
reflected P
multiple P
Time (s)
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
−2000 −1500 −1000 −500 0 500 1000 1500 2000
Receiver Position, m

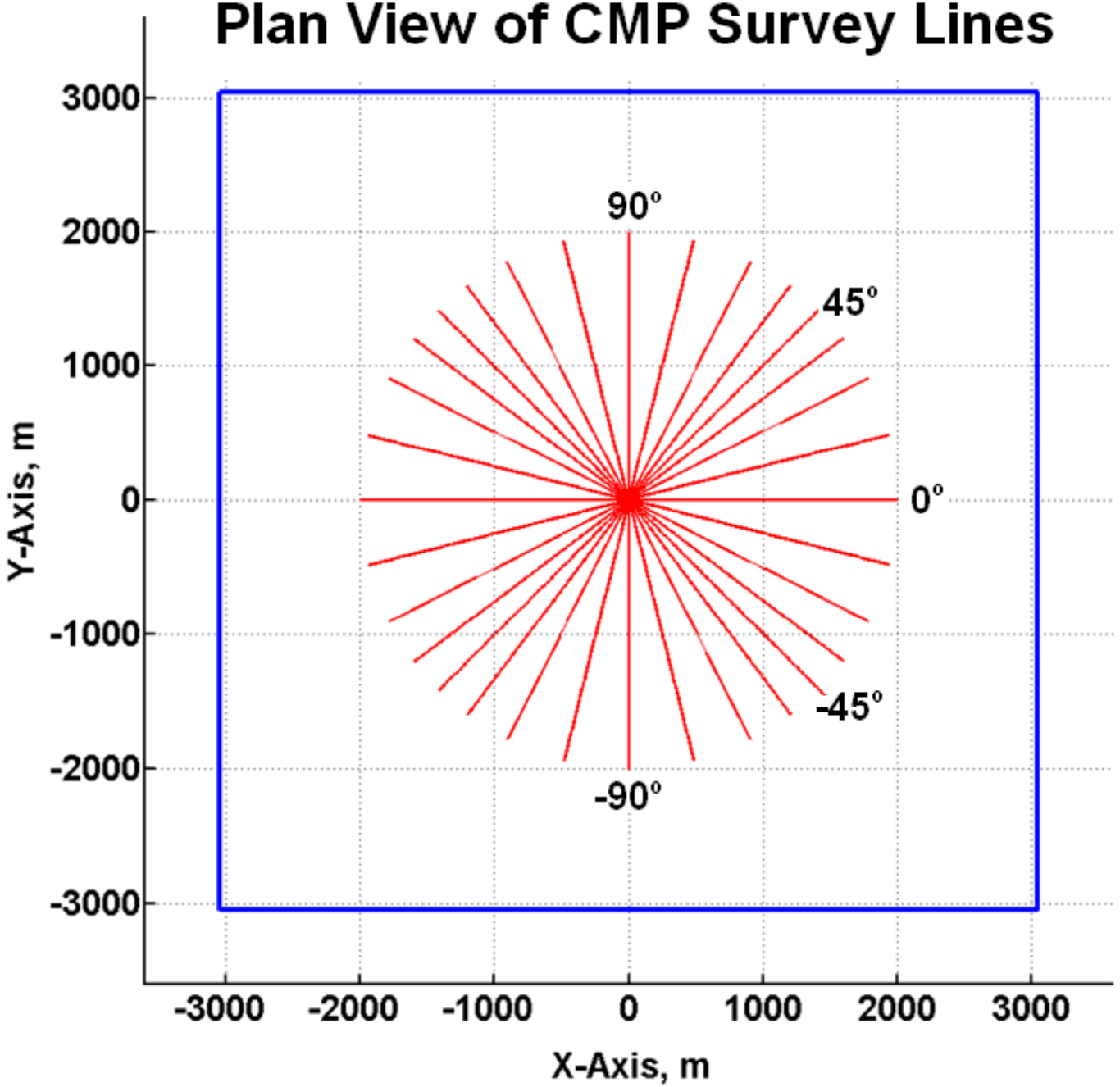

Propagation in x−z plane, transverse−component
direct SH
reflected SH
Time (s)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
−2000 −1500 −1000 −500 0 500 1000 1500 2000
Receiver Position, m

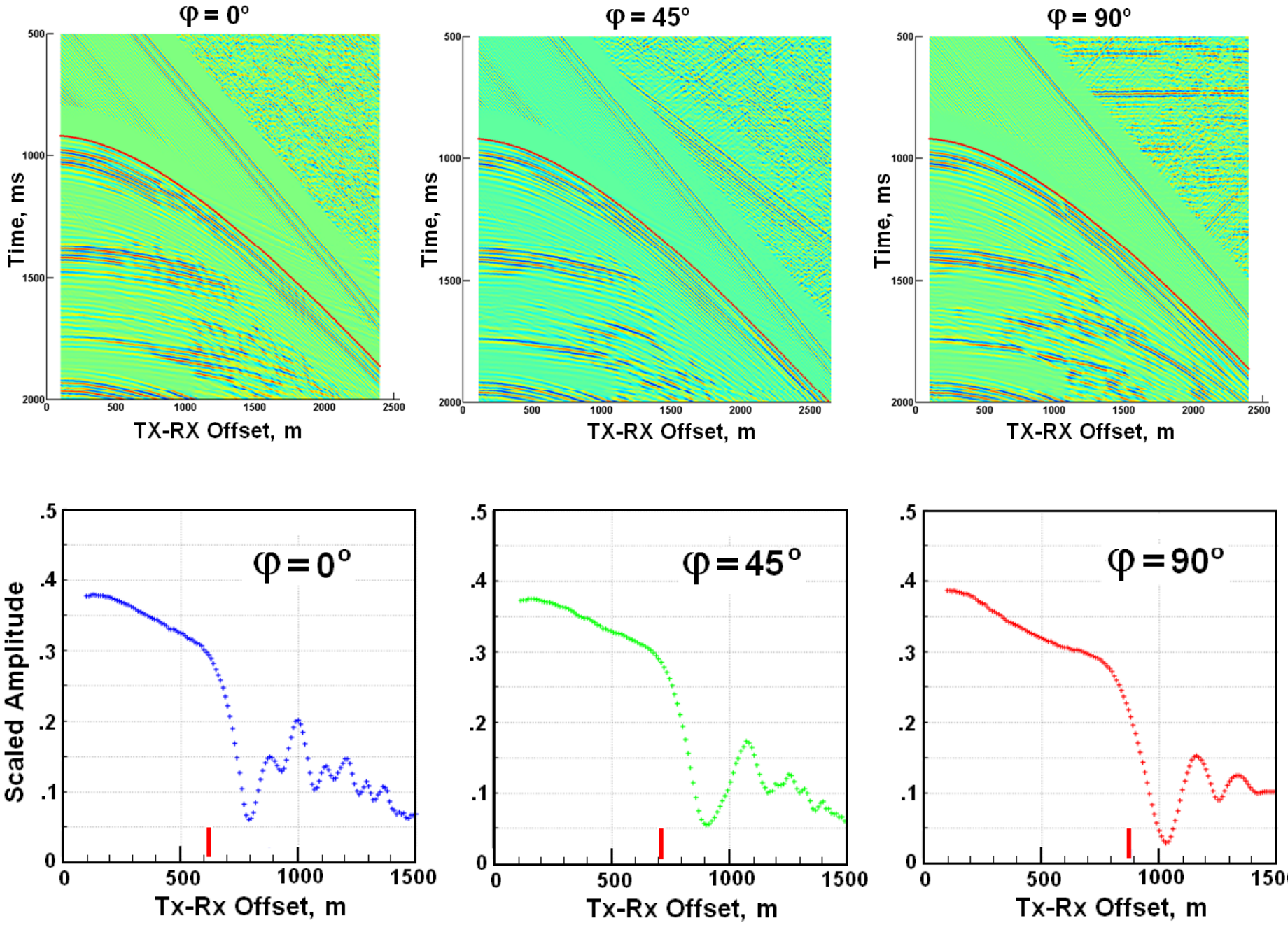

P-wave Group Velocity in x-y Plane
4000
3000
2000
1000
0
−1000
−200
−300
−4000
−4000
−2000
0
2000
4000
y-axis
x-axis
−14° azimuth
measured from x−profile
ellipse
measured from y−profile
measured from azimuth data


(a)
x−z plane
3500
0
θ
−3560
0
3560
(b)
y−z plane
3500
0
θ
−2950
0
2950
(c)
−45° azimuth plane
3500
0
θ
−3150
0
3150
(d)
+45° azimuth plane
3500
0
θ
−3150
0
3150

Acquiring Data for AVAZ Analysis


(a)
TX
RX
WATER
V_p = 1485 m/s
ρ = 1000 kg/m^3
Depth ~ 50 to 80 mm
69.2 mm
ORTHORHOMBIC
SOLID # 1
ACRYLIC PLASTIC
(b)
TX
RX
WATER
V_p = 1485 m/s
ρ = 1000 kg/m^3
Depth ~ 50 to 80 mm
50.8 mm
ACRYLIC PLASTIC
69.2 mm
ORTHORHOMBIC
SOLID # 1


Plan View of CMP Survey Lines
3000
2000
1000
0
-1000
-2000
-3000
Y-Axis, m
90°
45°
0°
-45°
-90°
-3000
-2000
-1000
0
1000
2000
3000
X-Axis, m


φ = 0°
φ = 45°
φ = 90°
Time, ms
TX-RX Offset, m
Scaled Amplitude
Tx-Rx Offset, m

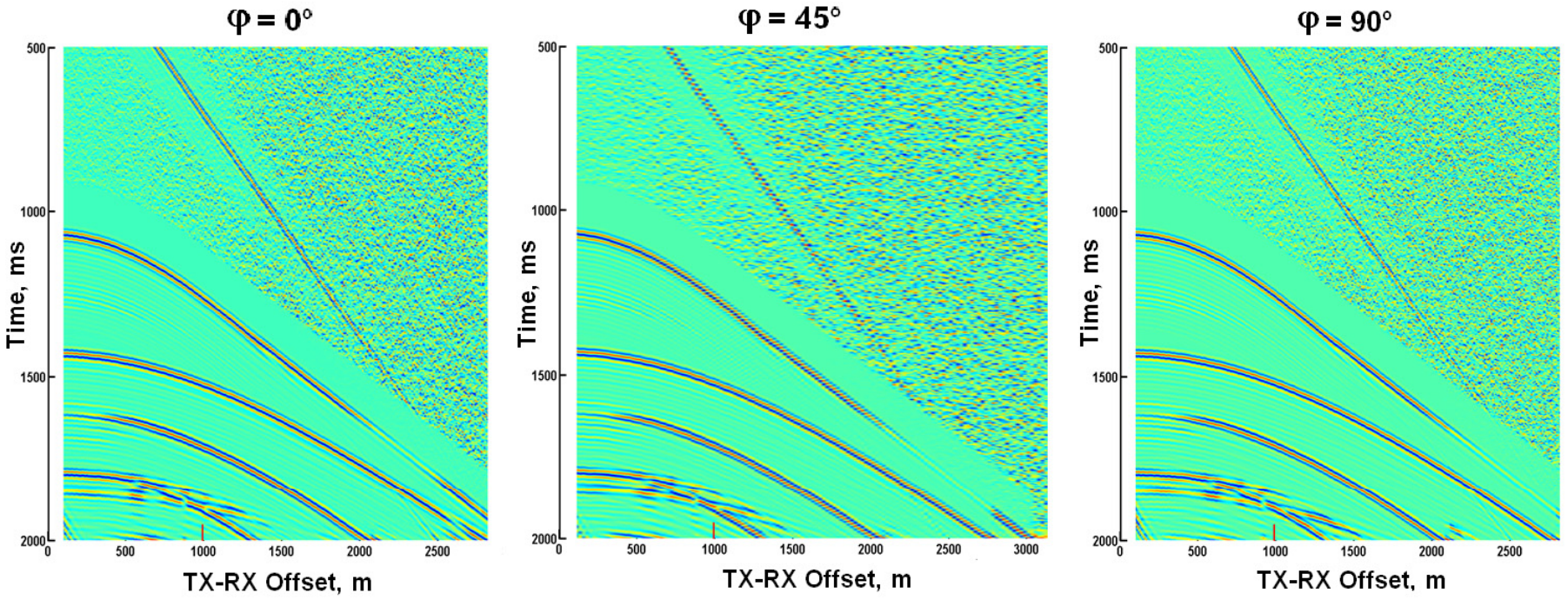
We want to compare measured reflection amplitudes to theoretical AVA/AVAZ predictions, but first we must:

(a) Verify that our acquisition subsystem is isotropic.

(b) Correct measured amplitudes for spherical divergence and source-receiver directivities.

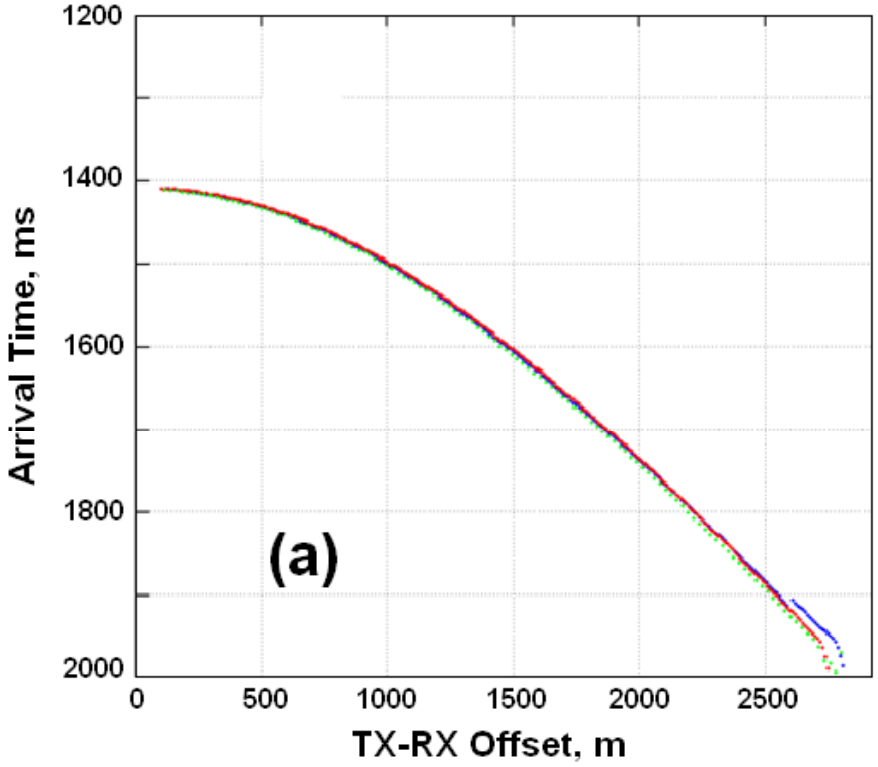
Pick NMO arrival times from the acrylic-phenolic interface.

Pick reflected amplitudes from the water-acrylic interface.

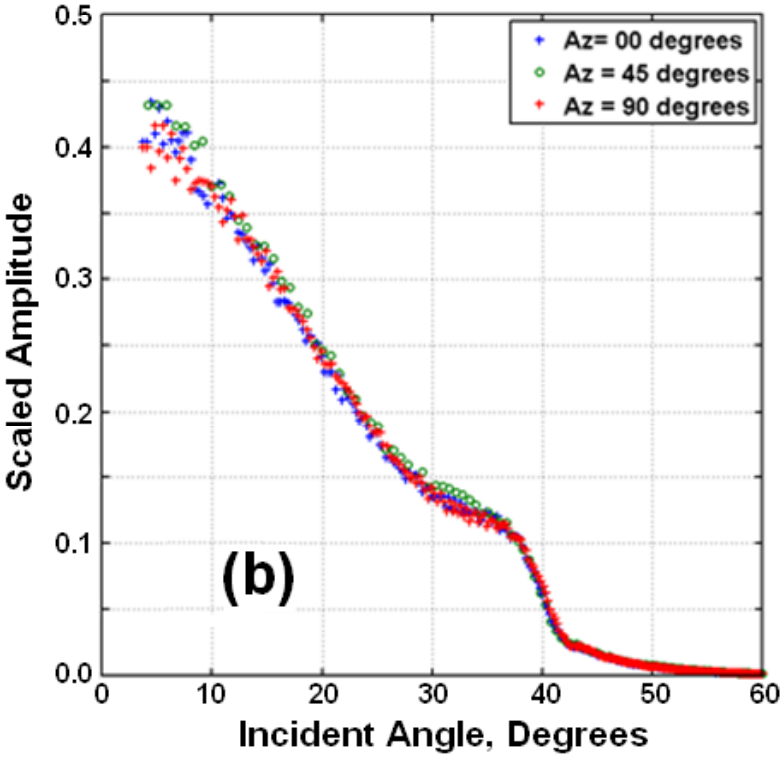


Azimuth angles φ = 0°, 45°, and 90°.

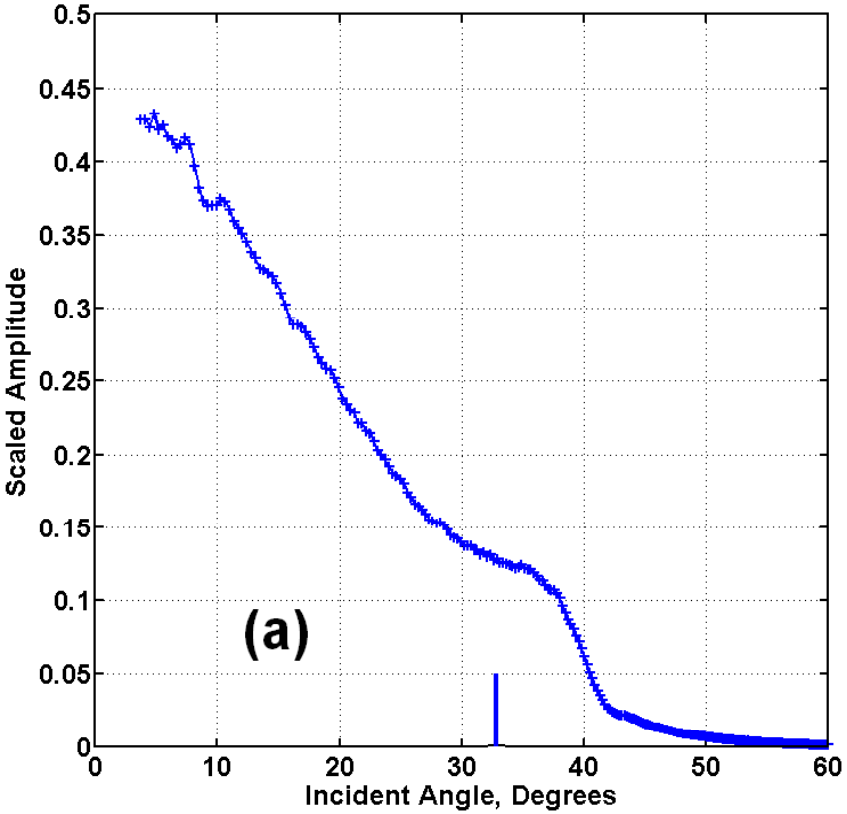
Arrival times

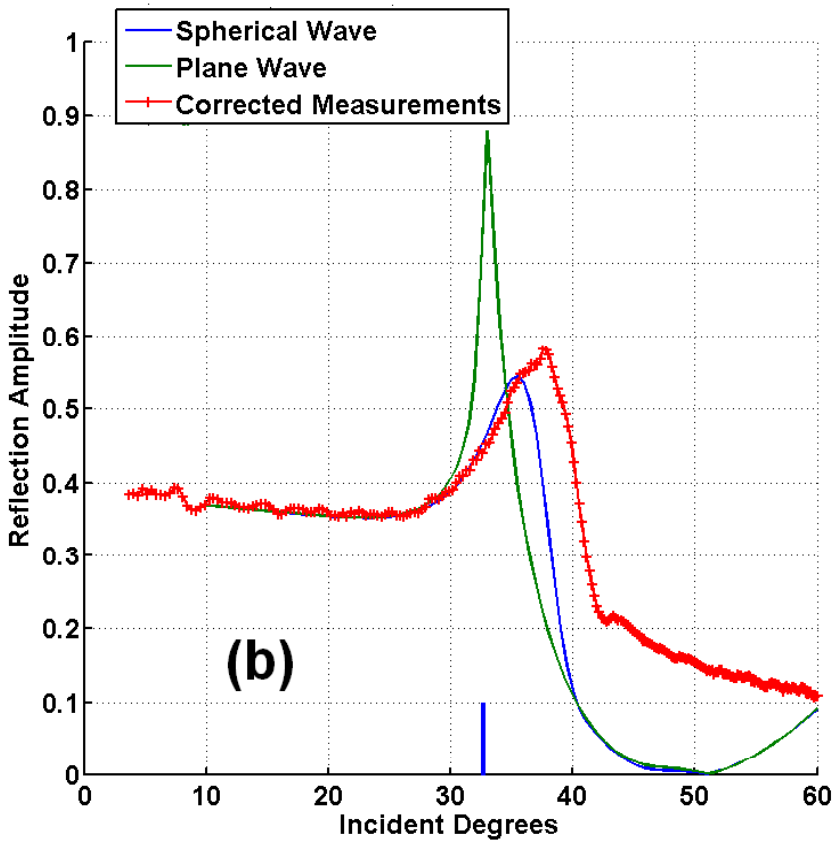


Raw Amplitudes



AVA ($\varphi = 0°$) for the Water-Acrylic Reflection

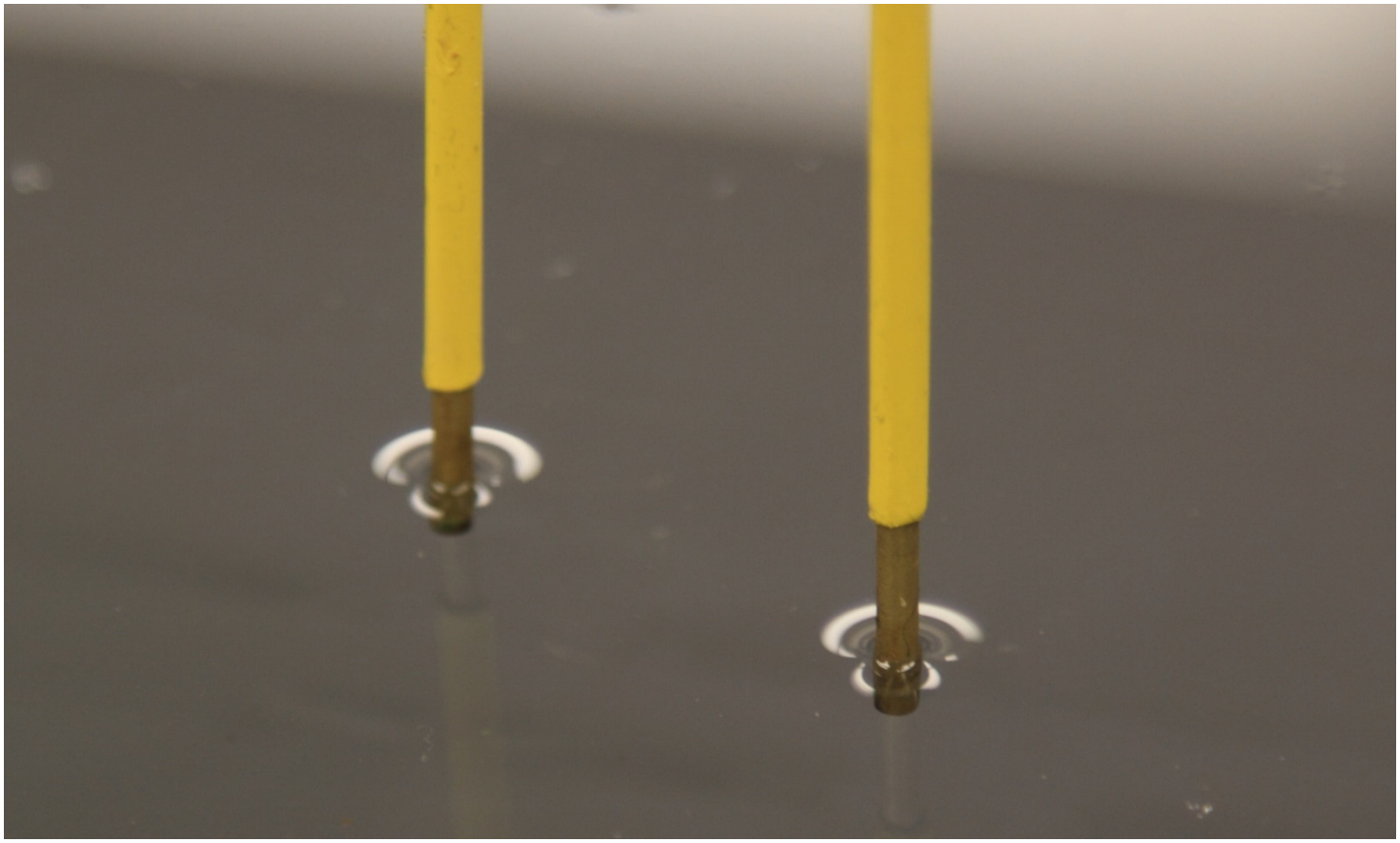


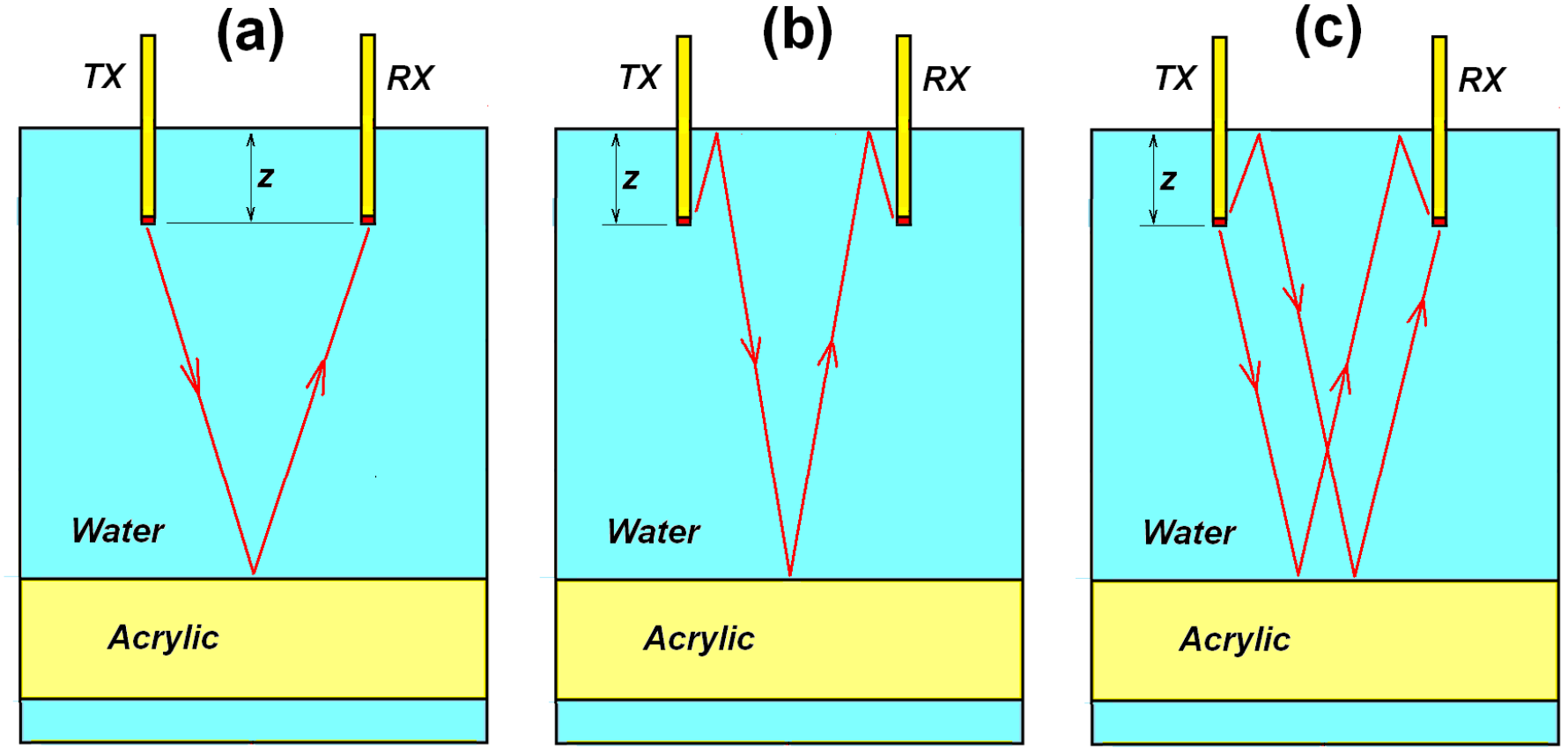


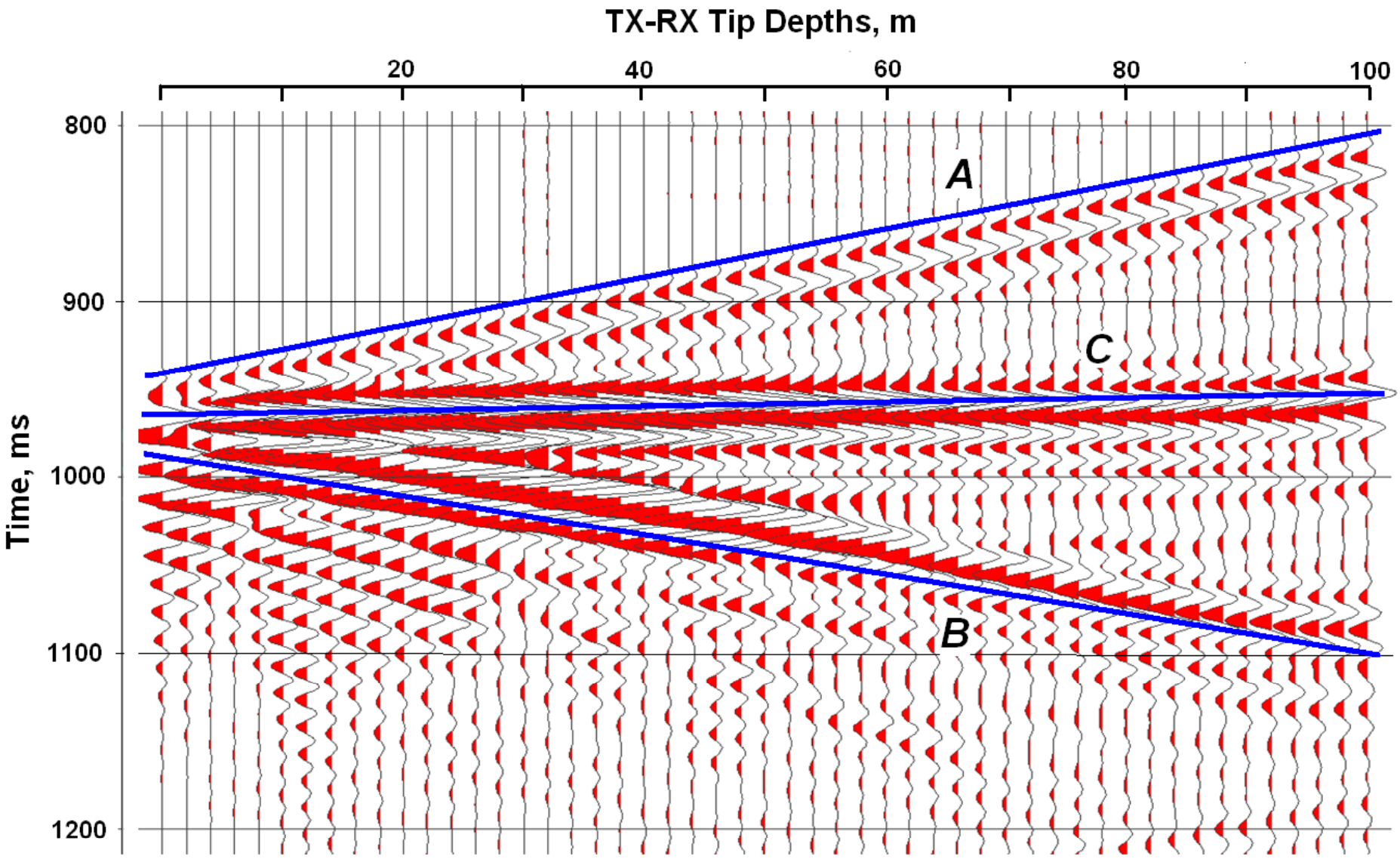
(a) Raw picked amplitudes.

(b) Corrected amplitudes compared with predictions.

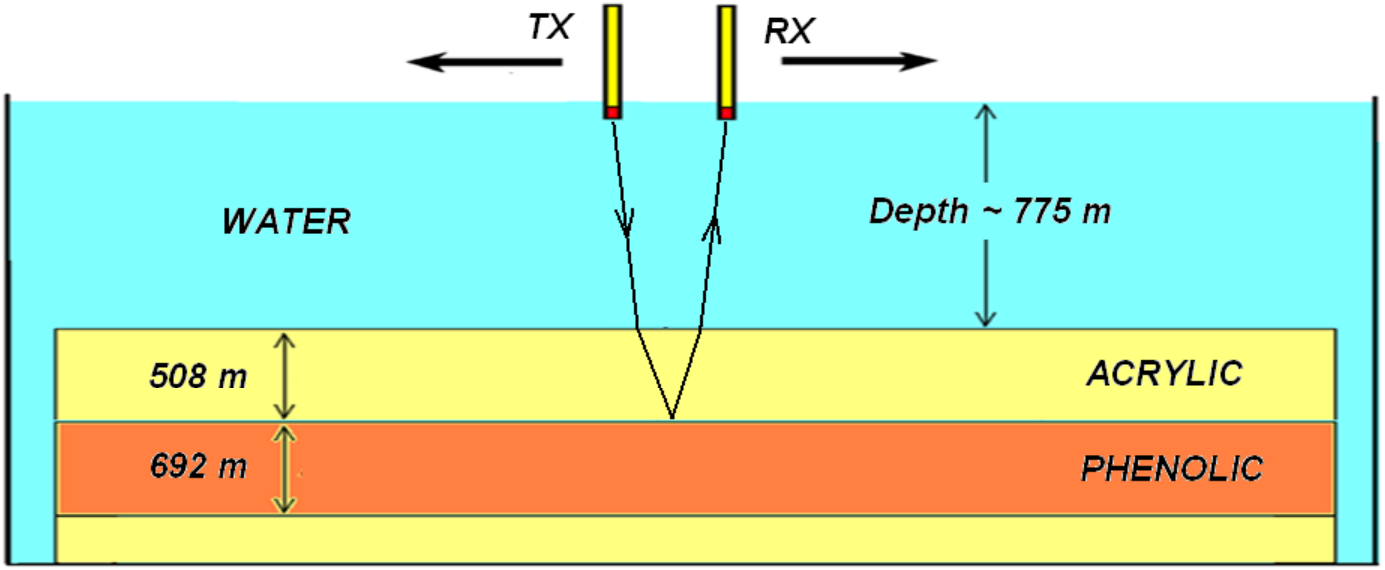
Wavelet Shapes

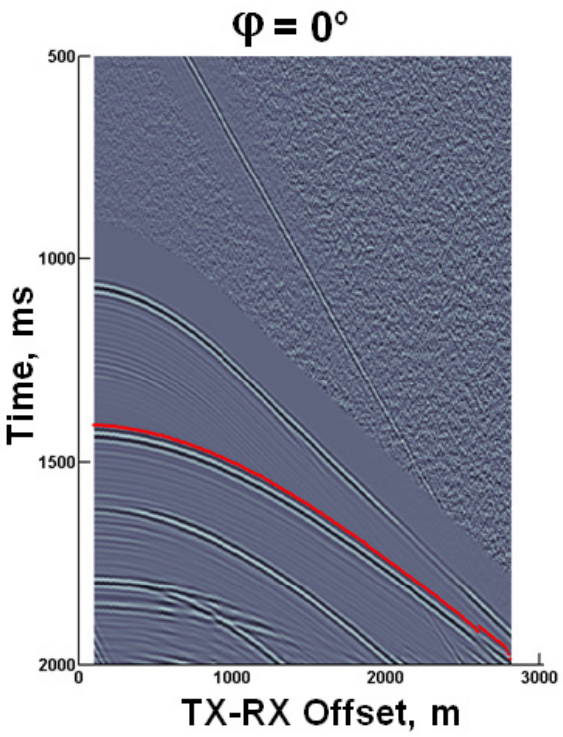


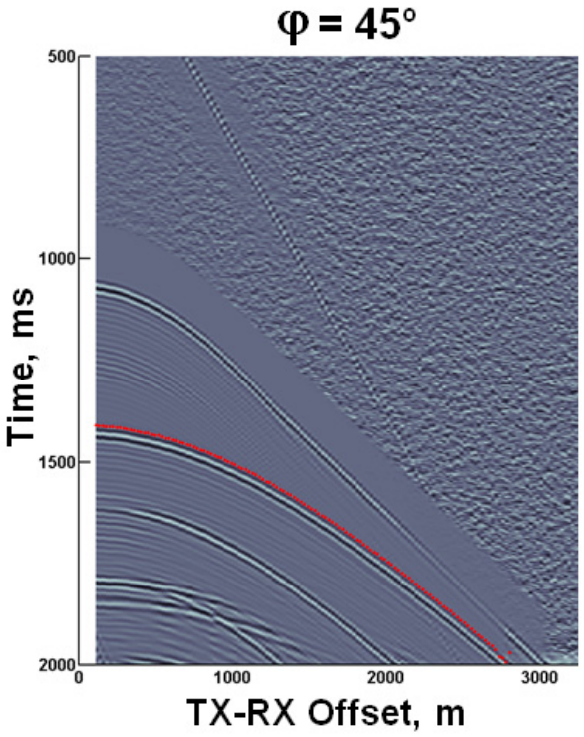

(a)
TX
RX
z
Water
Acrylic
(b)
TX
RX
z
Water
Acrylic
(c)
TX
RX
z
Water
Acrylic

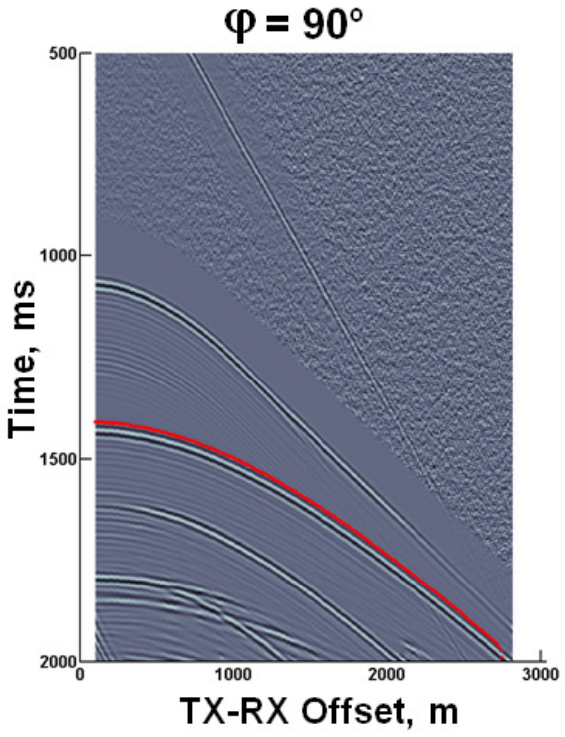

TX-RX Tip Depths, m
20
40
60
80
100
800
900
1000
1100
1200
Time, ms
A
B
C

Analysis of Reflected Amplitudes from the Acrylic-Phenolic Interface

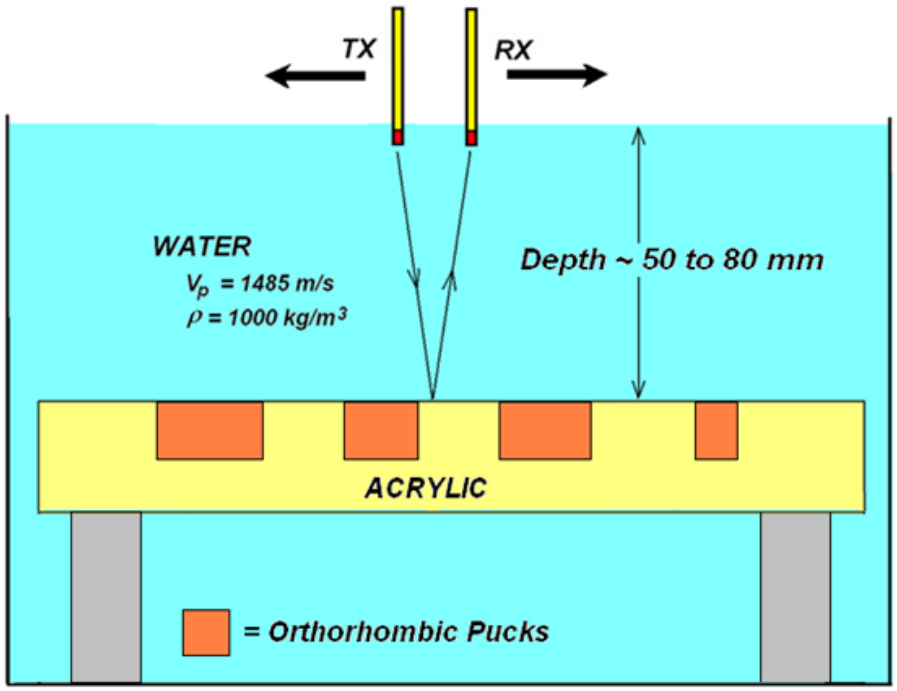

TX
RX
WATER
Depth ~ 775 m
508 m
ACRYLIC
692 m
PHENOLIC


φ = 0°
Time, ms
TX-RX Offset, m
500
1000
1500
2000
0
1000
2000
3000

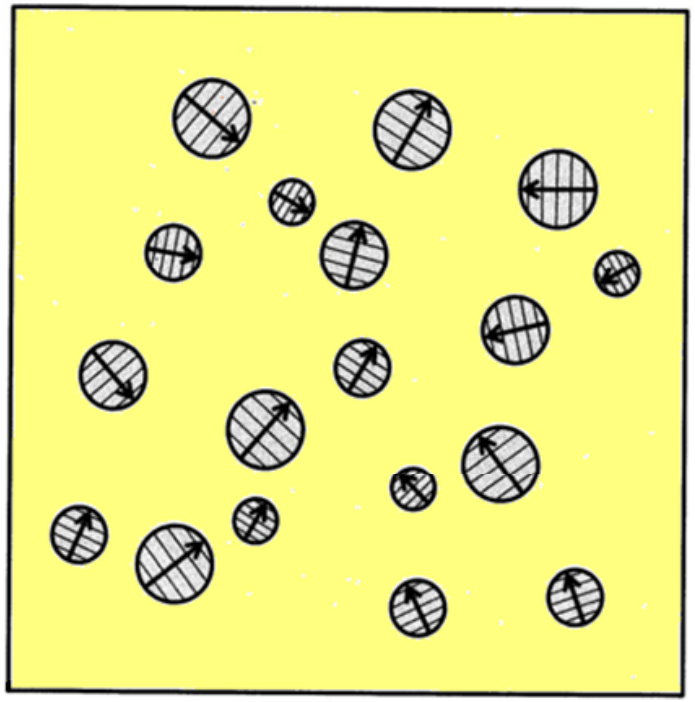

φ = 45°
Time, ms
TX-RX Offset, m
500
1000
1500
2000
0
1000
2000
3000


φ = 90°
Time, ms
TX-RX Offset, m
500
1000
1500
2000
0
1000
2000
3000

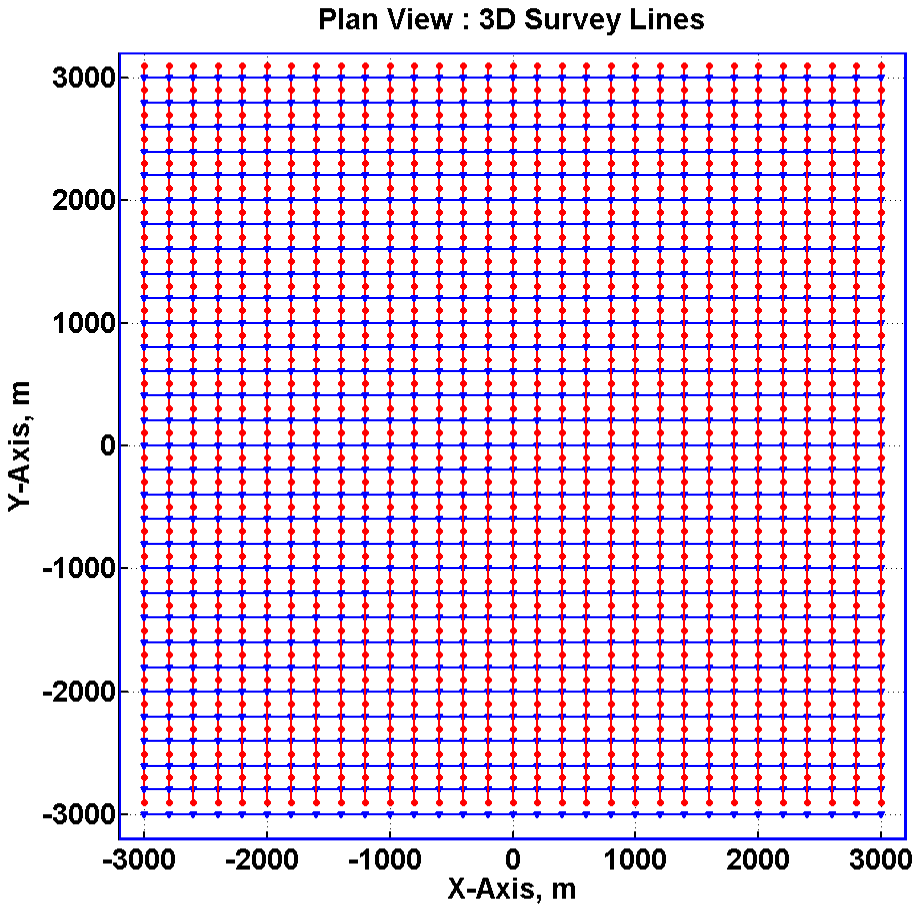
PLANNED MARINE 3D SURVEY

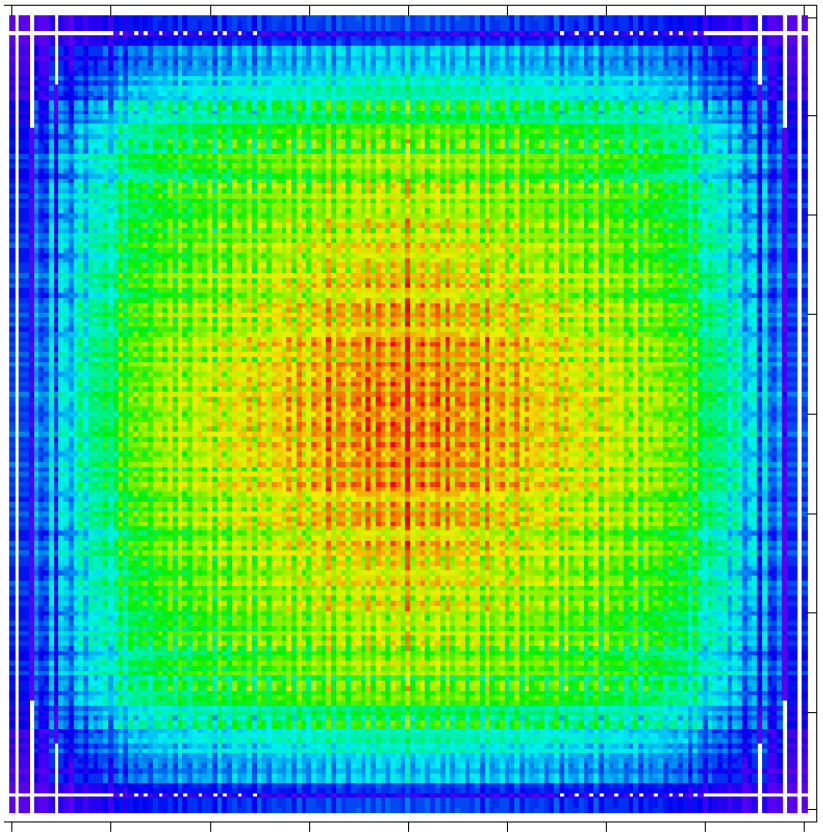


(a) Side View



(b) Plan View


Plan View : 3D Survey Lines
3000
2000
1000
0
-1000
-2000
-3000
Y-Axis, m
-3000
-2000
-1000
0
1000
2000
3000
X-Axis, m



Summary

1. *Reflection amplitudes intended for AVAZ analysis must be picked carefully, due to the complexity of the reflected wavelets.*

2. *Amplitudes must be corrected for spherical spreading and TX-RX directivities before comparing to AVA/AVAZ predictions.*

3. *The physically-modeled seismograms are stored on SEG-Y files that are available to sponsors upon request.*

ACKNOWLEDGEMENTS

This research was supported by NSERC and the industrial sponsors of CREWES.