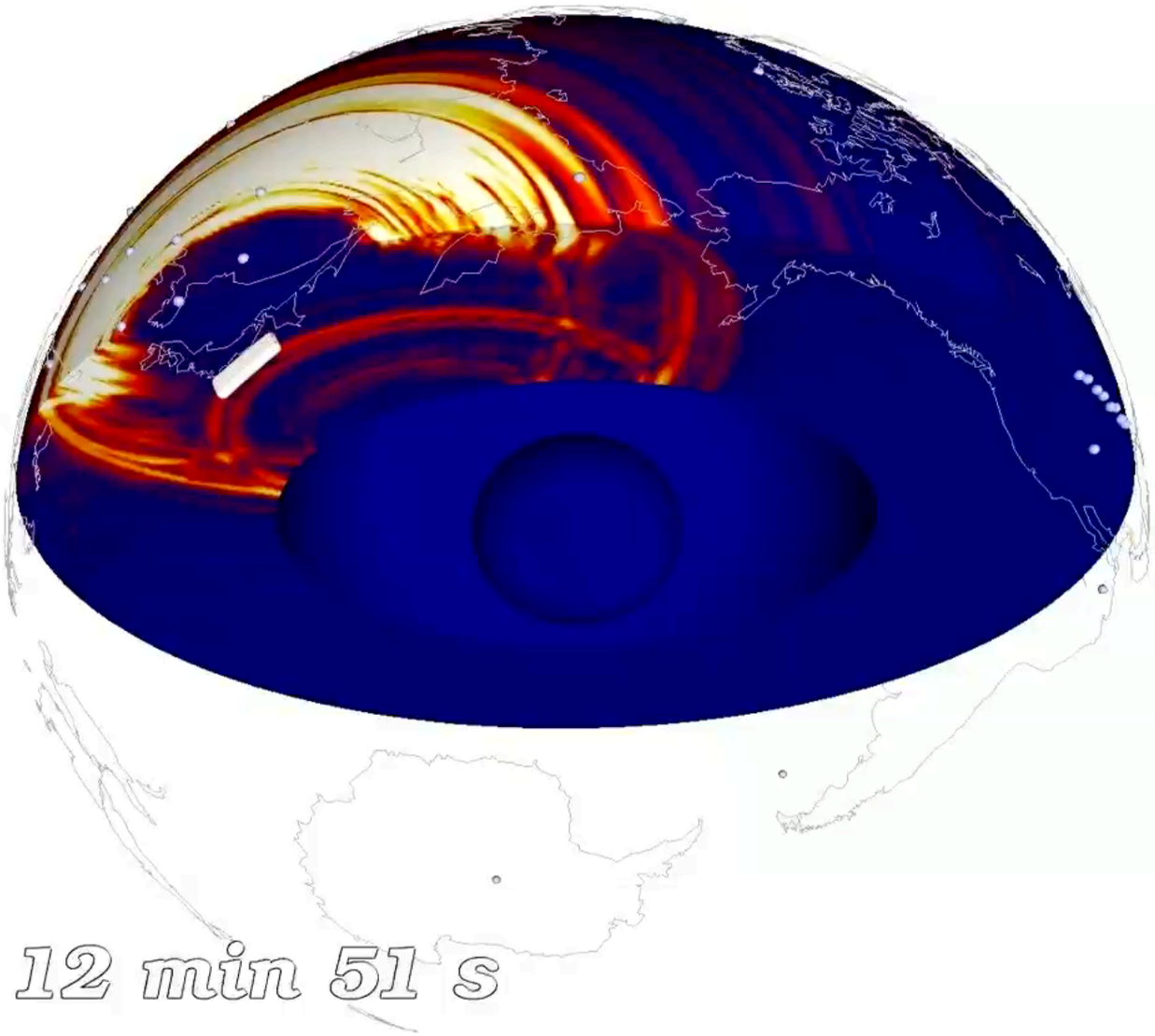
Surface waves

time= 1001.0s
01:15:34 UTC

SEISMOLOGICAL LABORATORY

CACR


12 min 51 s

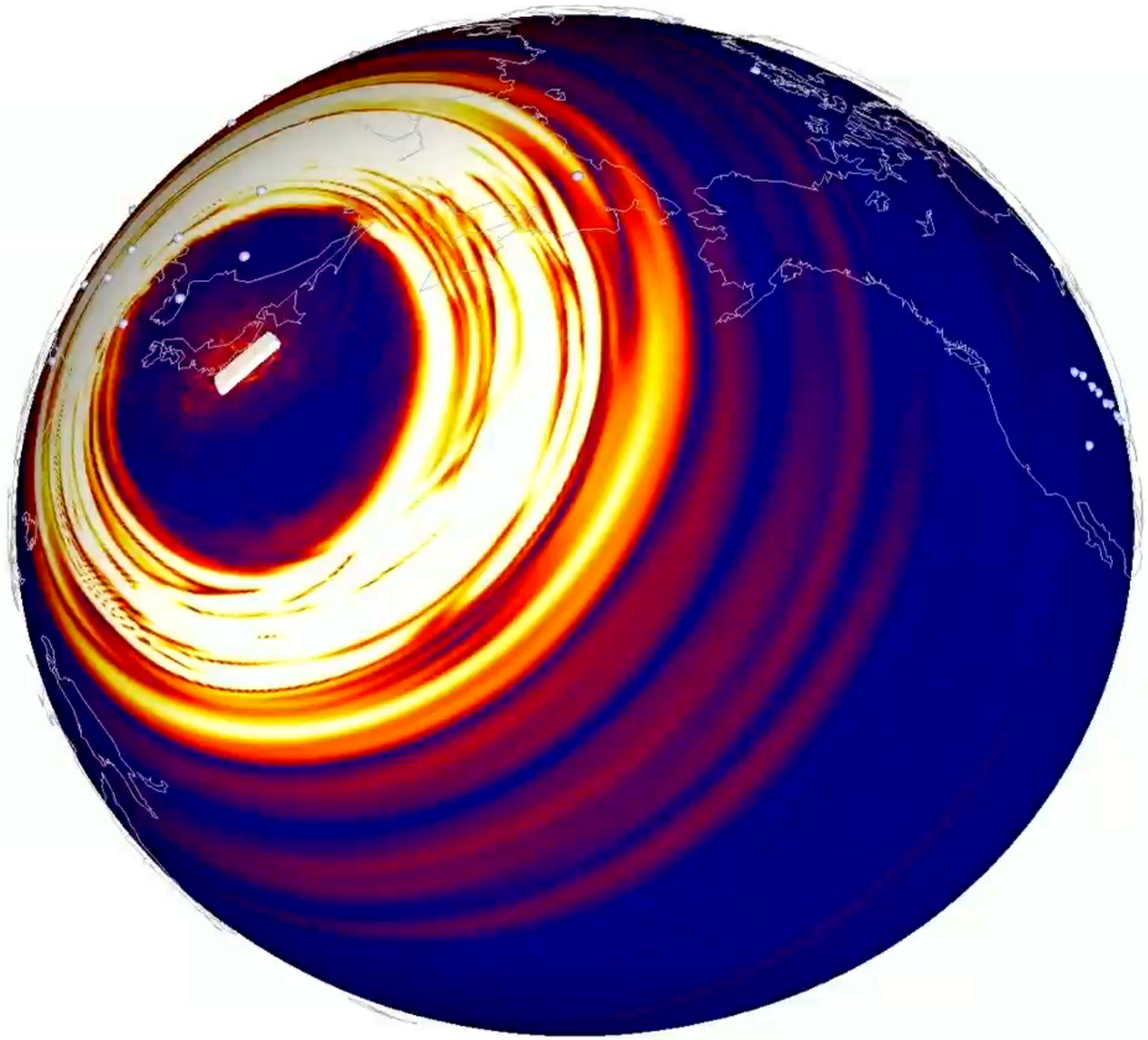
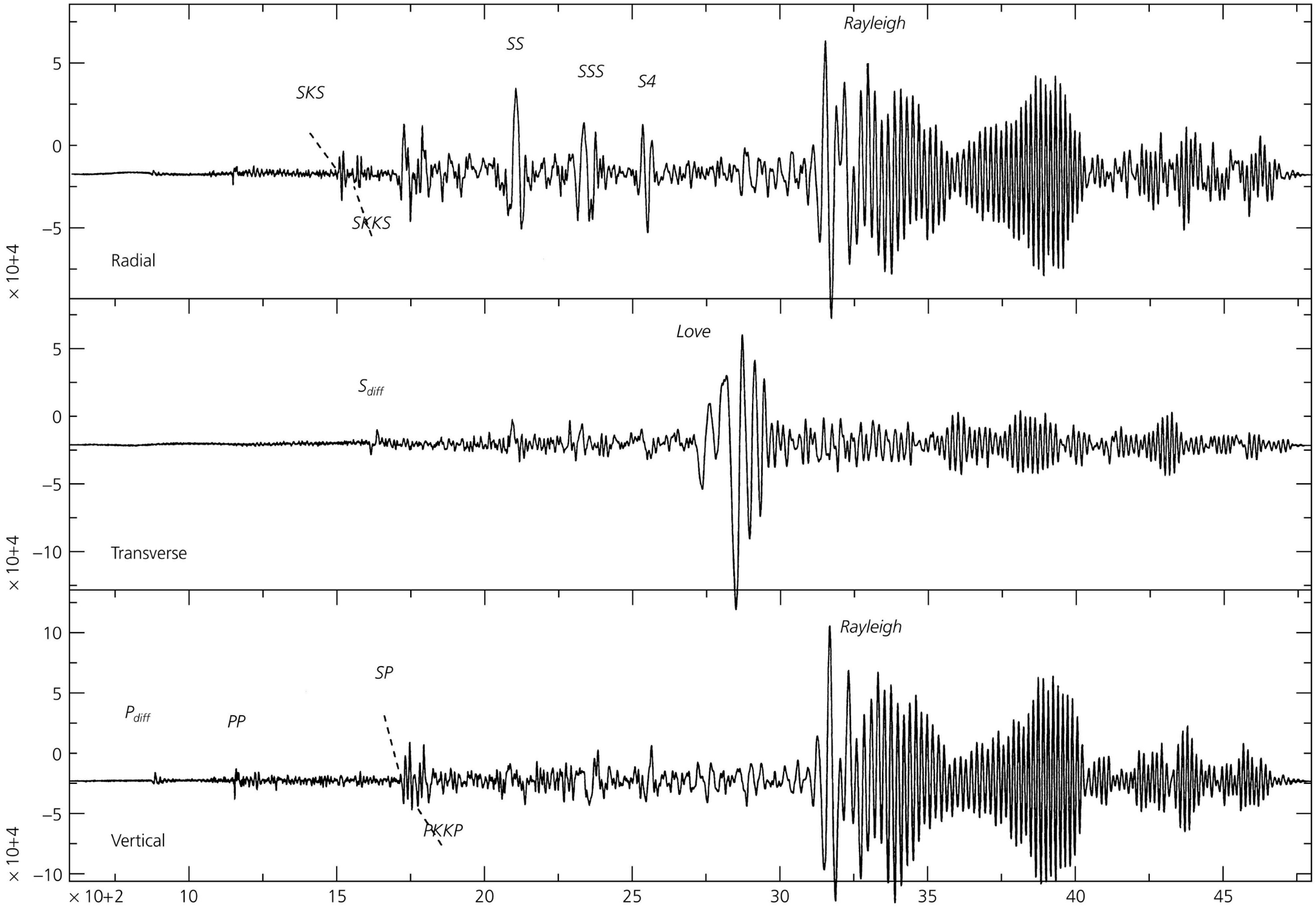
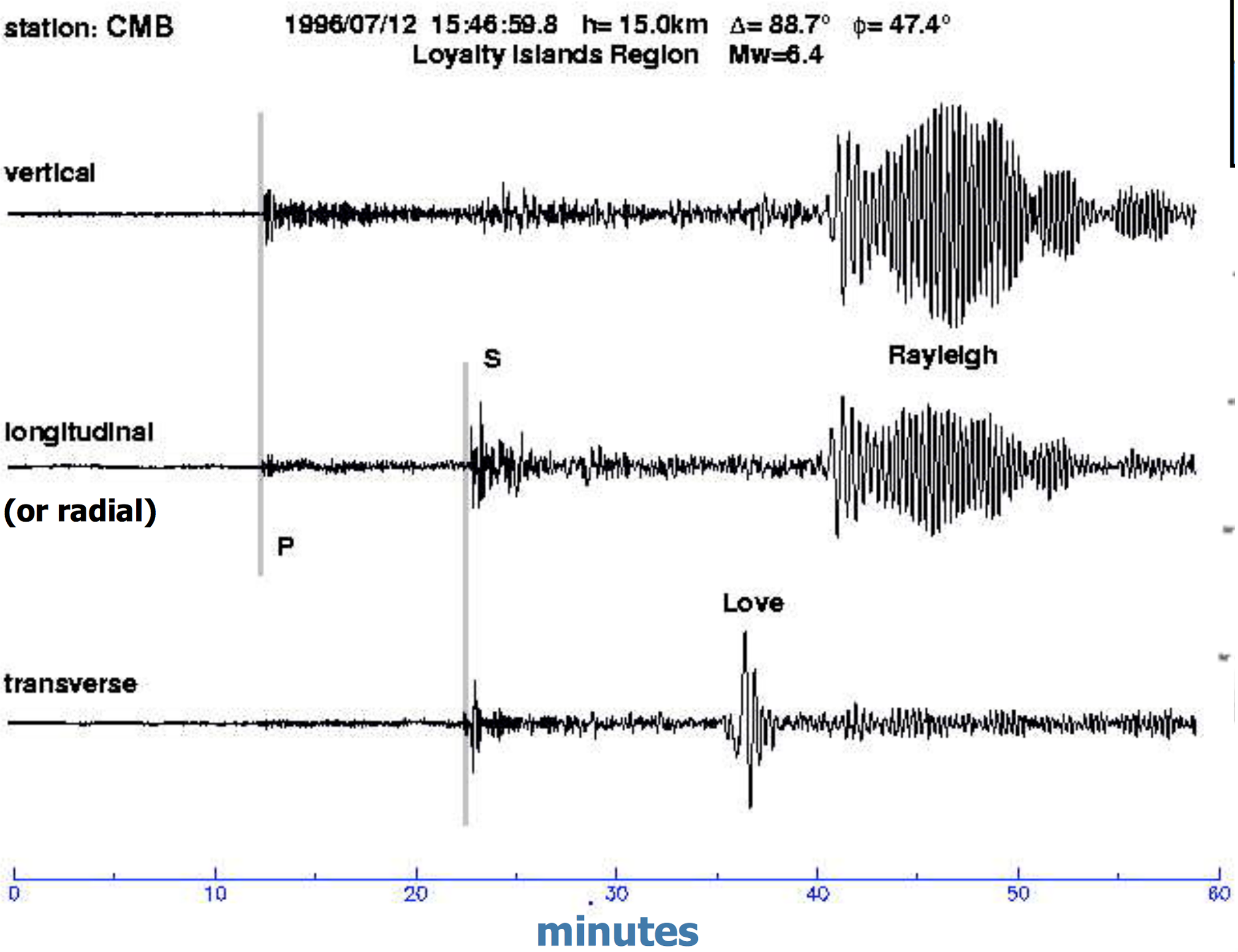


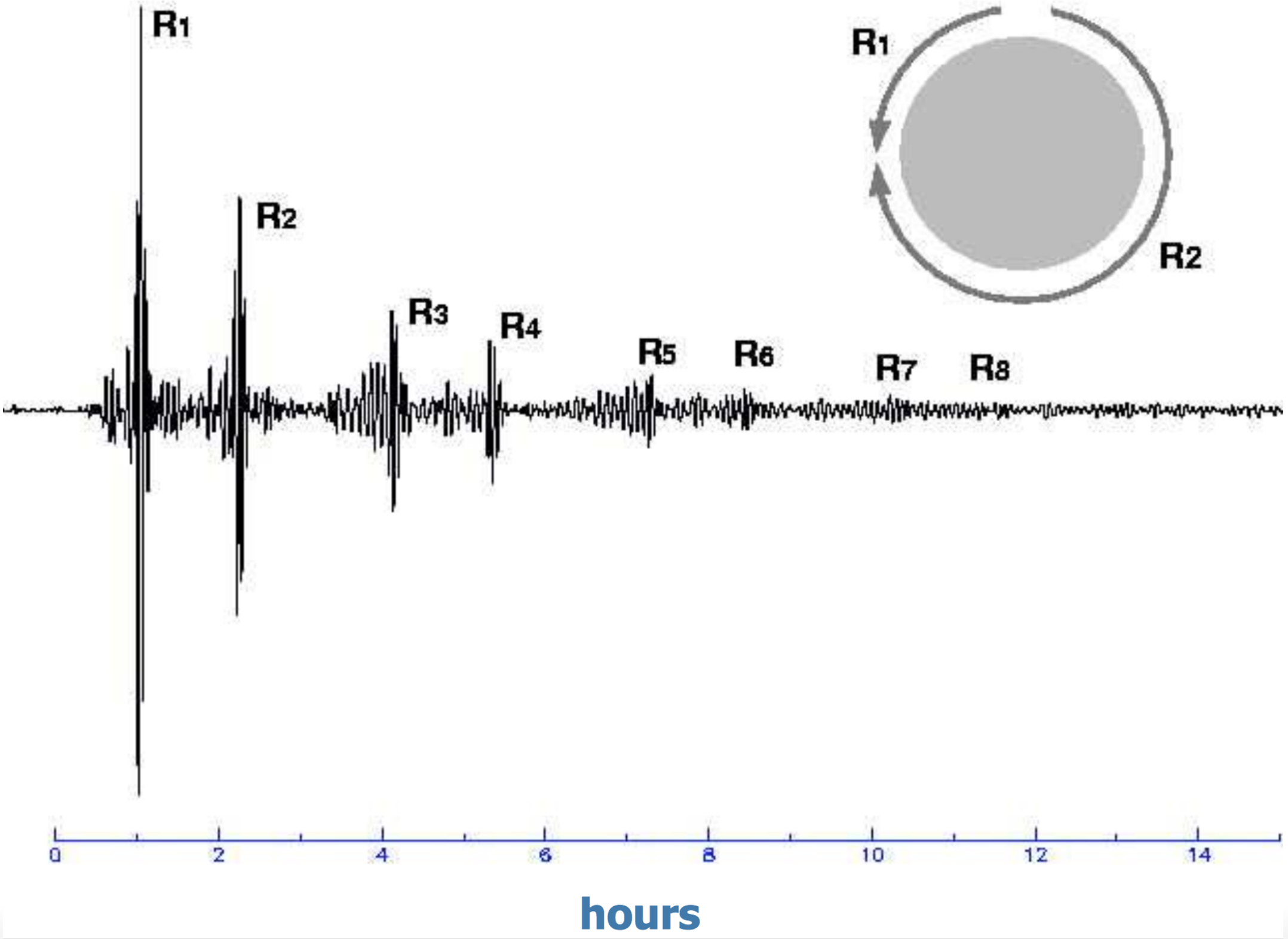
Figure 2.7-1: Seismograms recorded at a distance of 110°, showing surface waves.



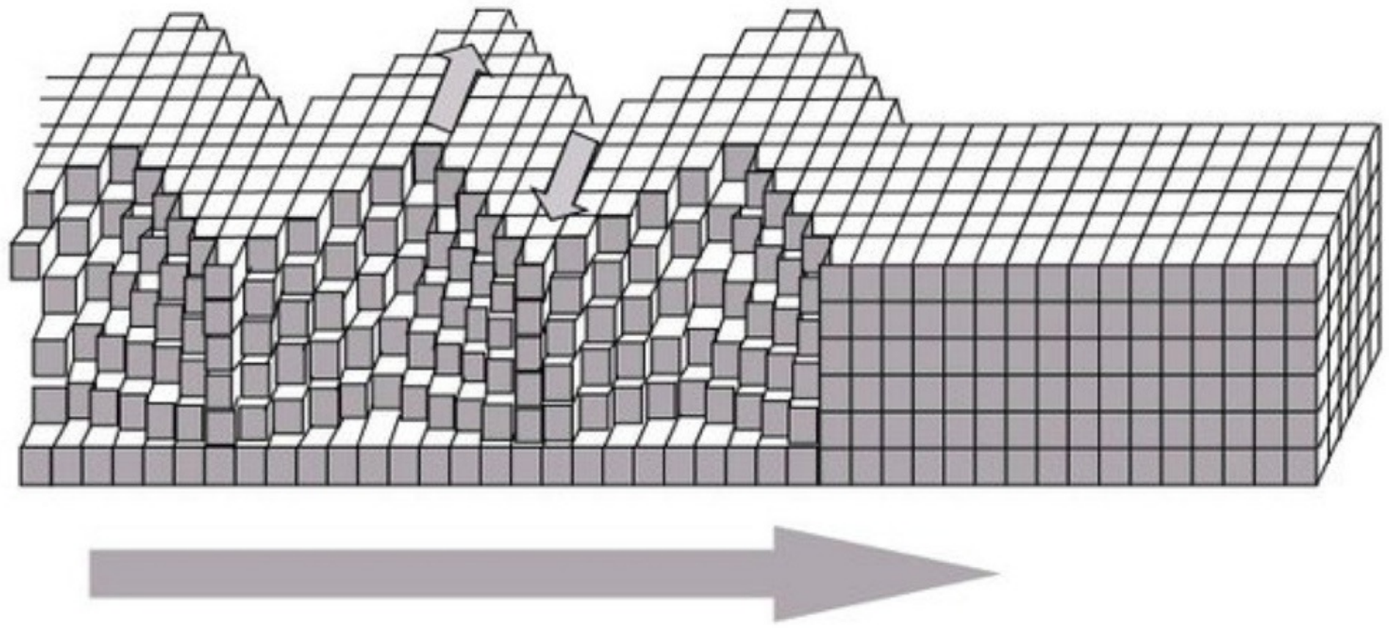

station: CMB
1996/07/12 15:46:59.8 h= 15.0km Δ= 88.7° φ= 47.4°
Loyalty Islands Region Mw=6.4
vertical
S
Rayleigh
longitudinal
(or radial)
P
Love
transverse
0
10
20
30
40
50
60
minutes

station: CMB
channel: LHZ

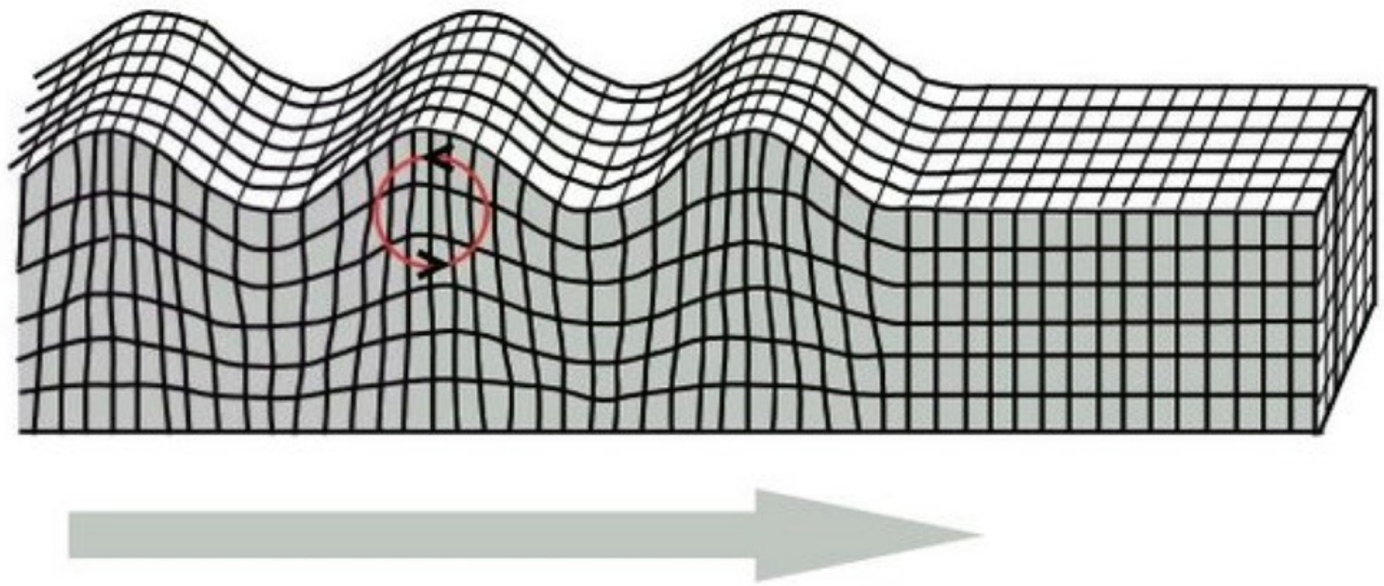
1996/07/11 21:46:39.7 h= 15.0km Δ=109.7° ϕ= 32.3°
Burma-China Border Region Mw=6.8

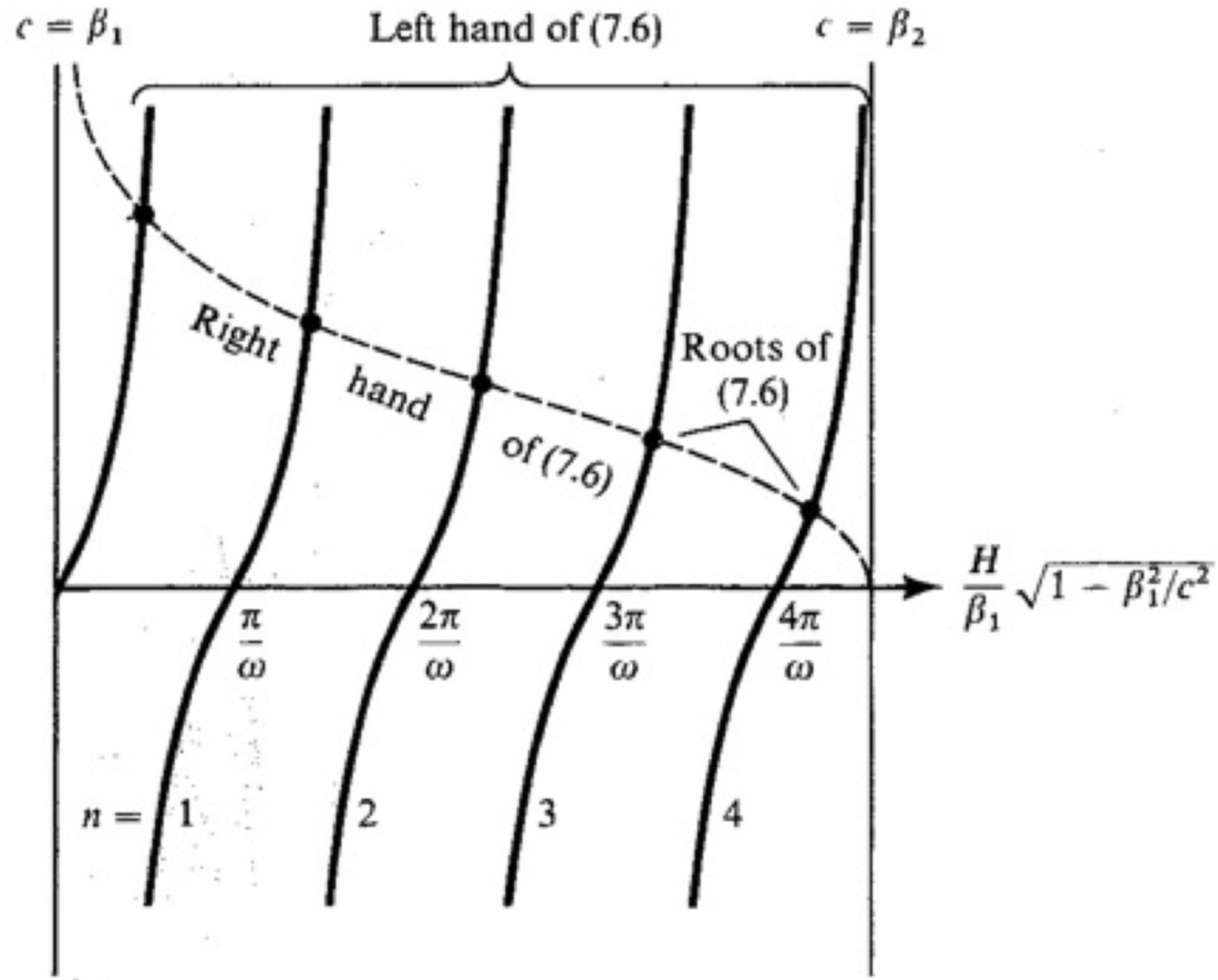


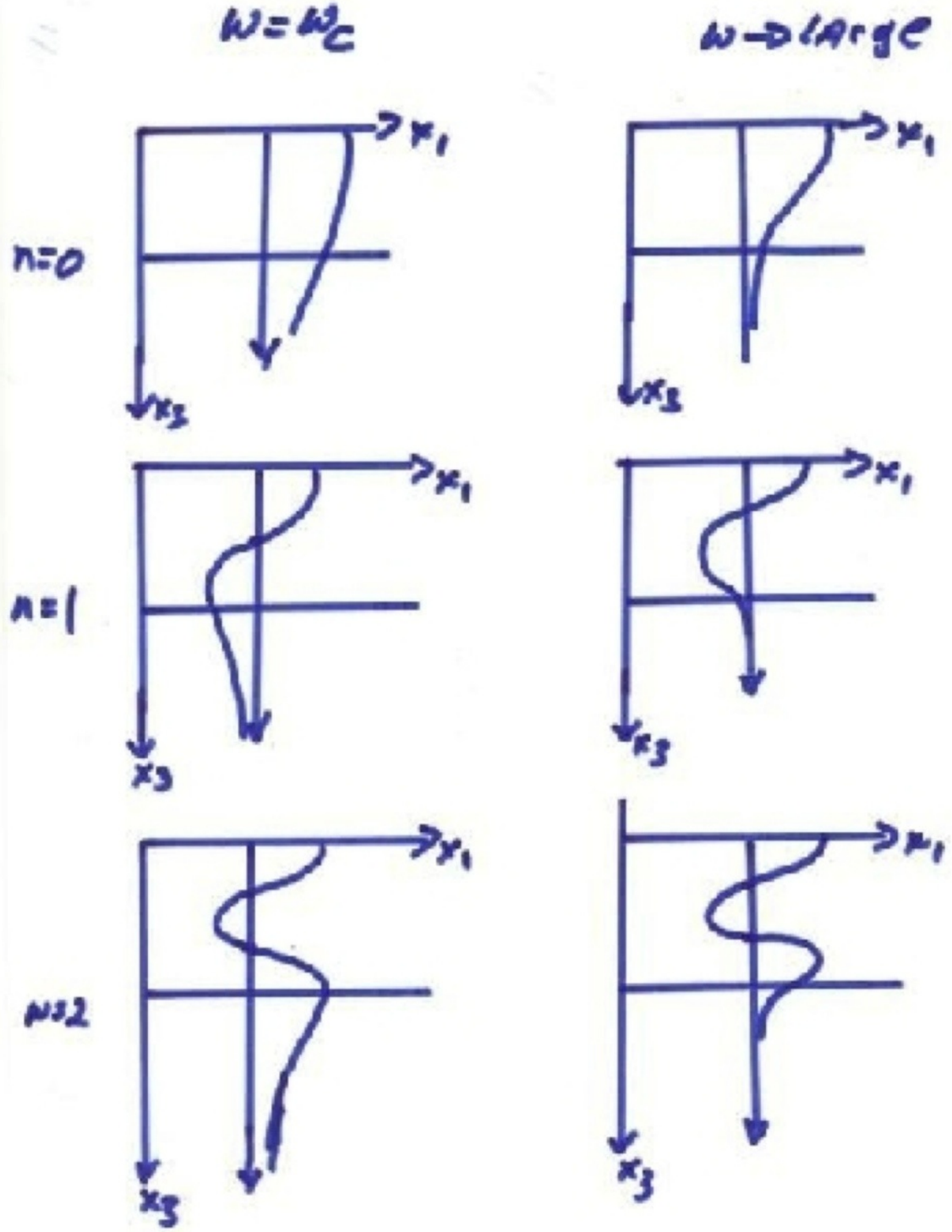
Love Wave

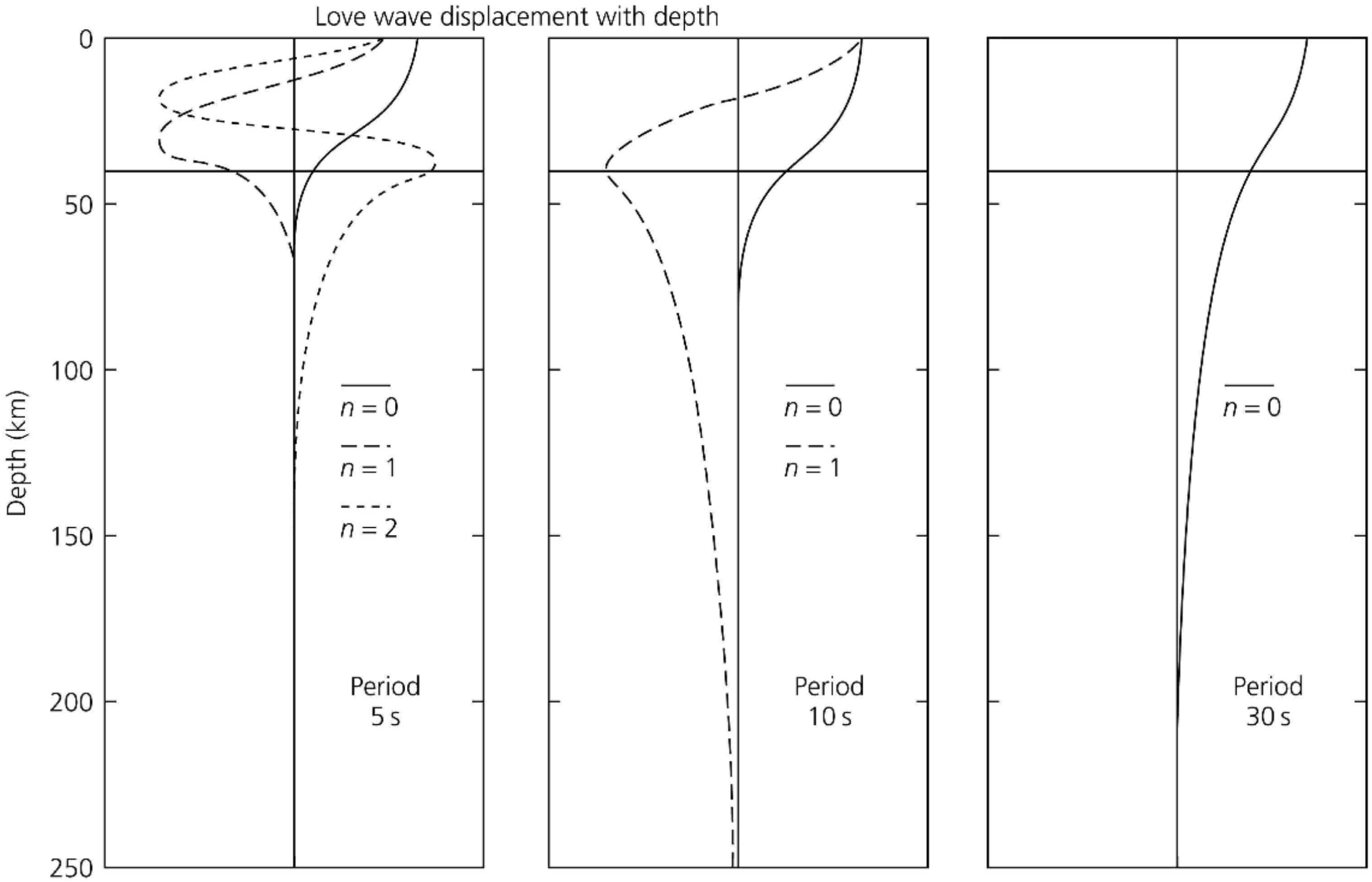


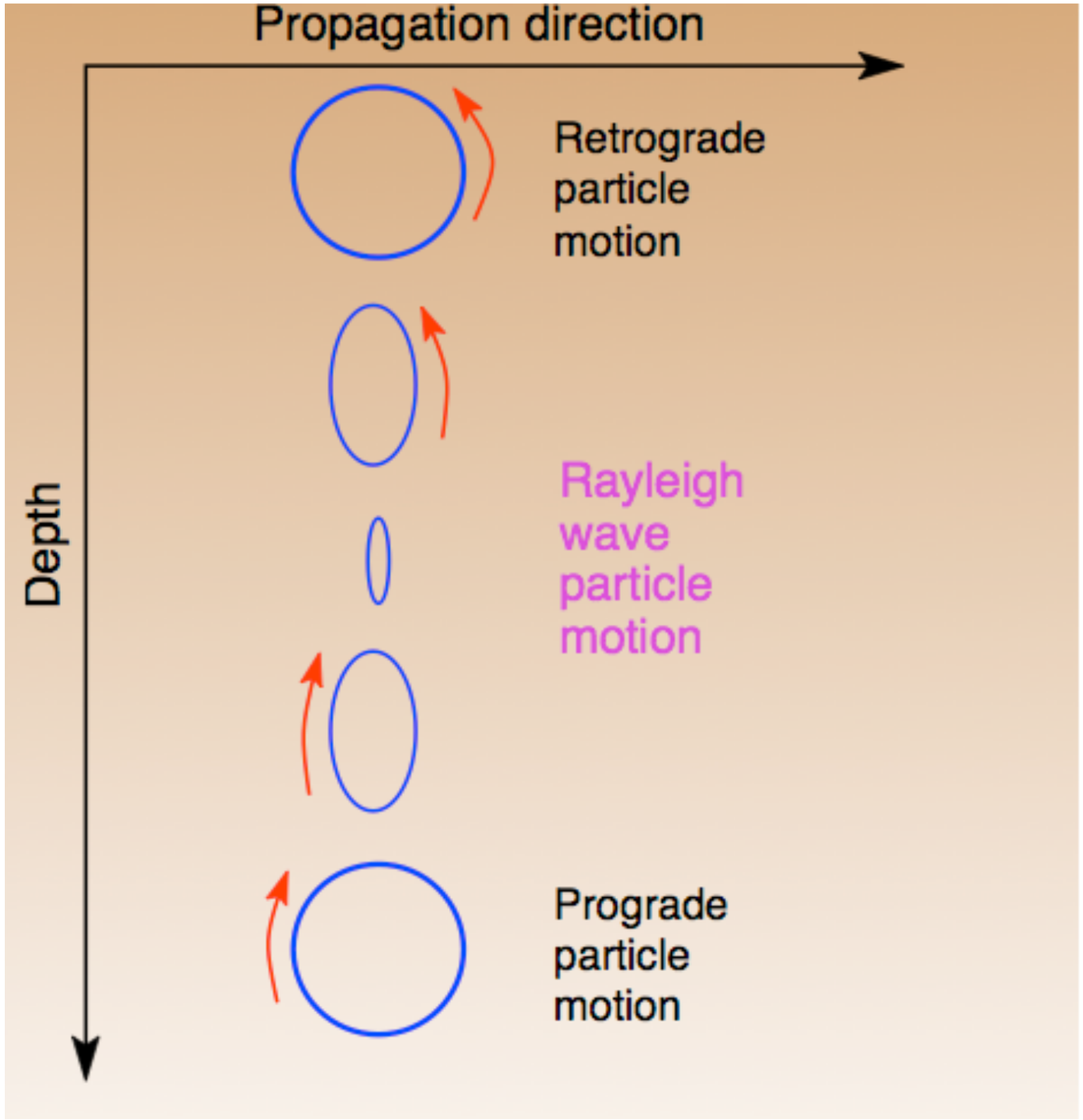
Rayleigh Wave

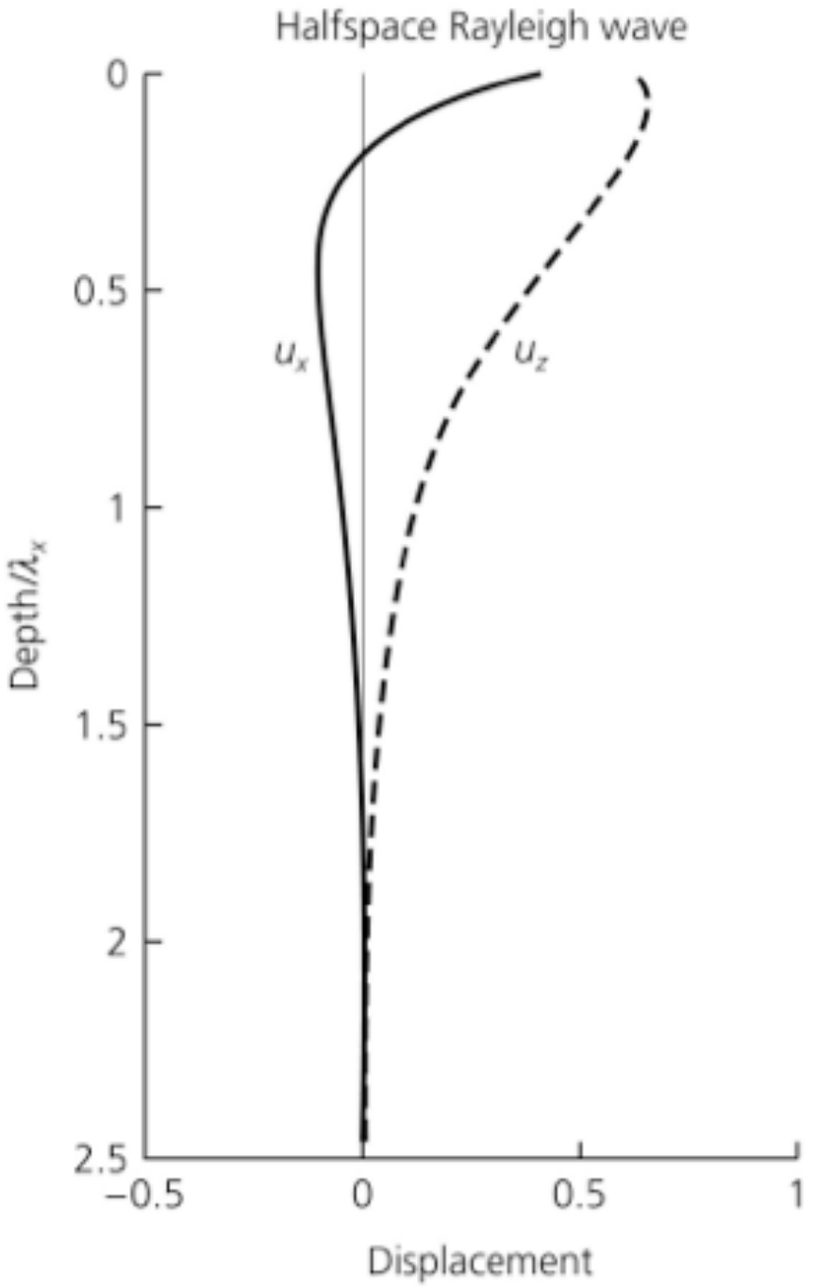



$c = \beta_1$
Left hand of (7.6)
$c = \beta_2$
Right hand of (7.6)
Roots of (7.6)
$\frac{H}{\beta_1}\sqrt{1-\beta_1^2/c^2}$
$\frac{\pi}{\omega}$
$\frac{2\pi}{\omega}$
$\frac{3\pi}{\omega}$
$\frac{4\pi}{\omega}$
$n =$ 1
2
3
4


ω = ω_c
ω → large
n=0
n=1
n=2
x1
x3

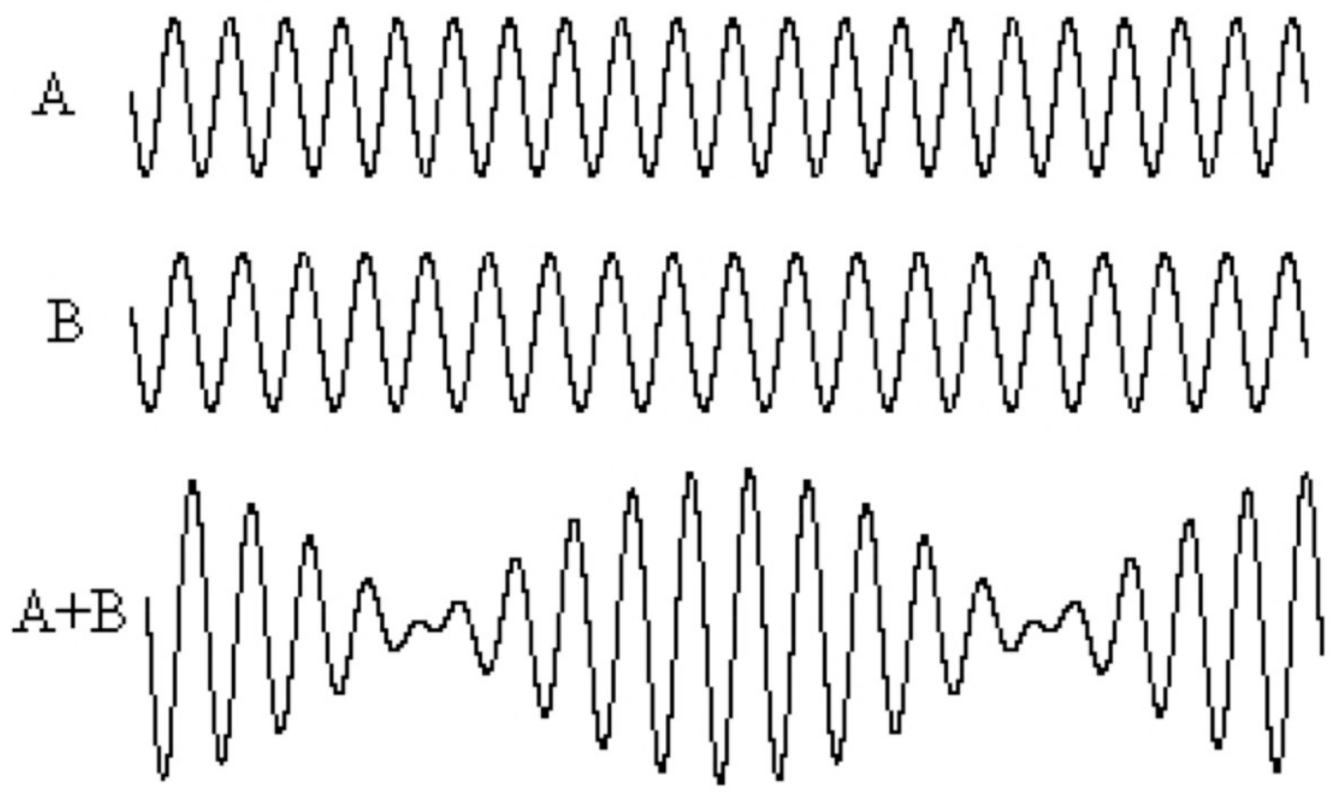

Love wave displacement with depth
Depth (km)
0
50
100
150
200
250
n = 0
n = 1
n = 2
Period
5 s
n = 0
n = 1
Period
10 s
n = 0
Period
30 s

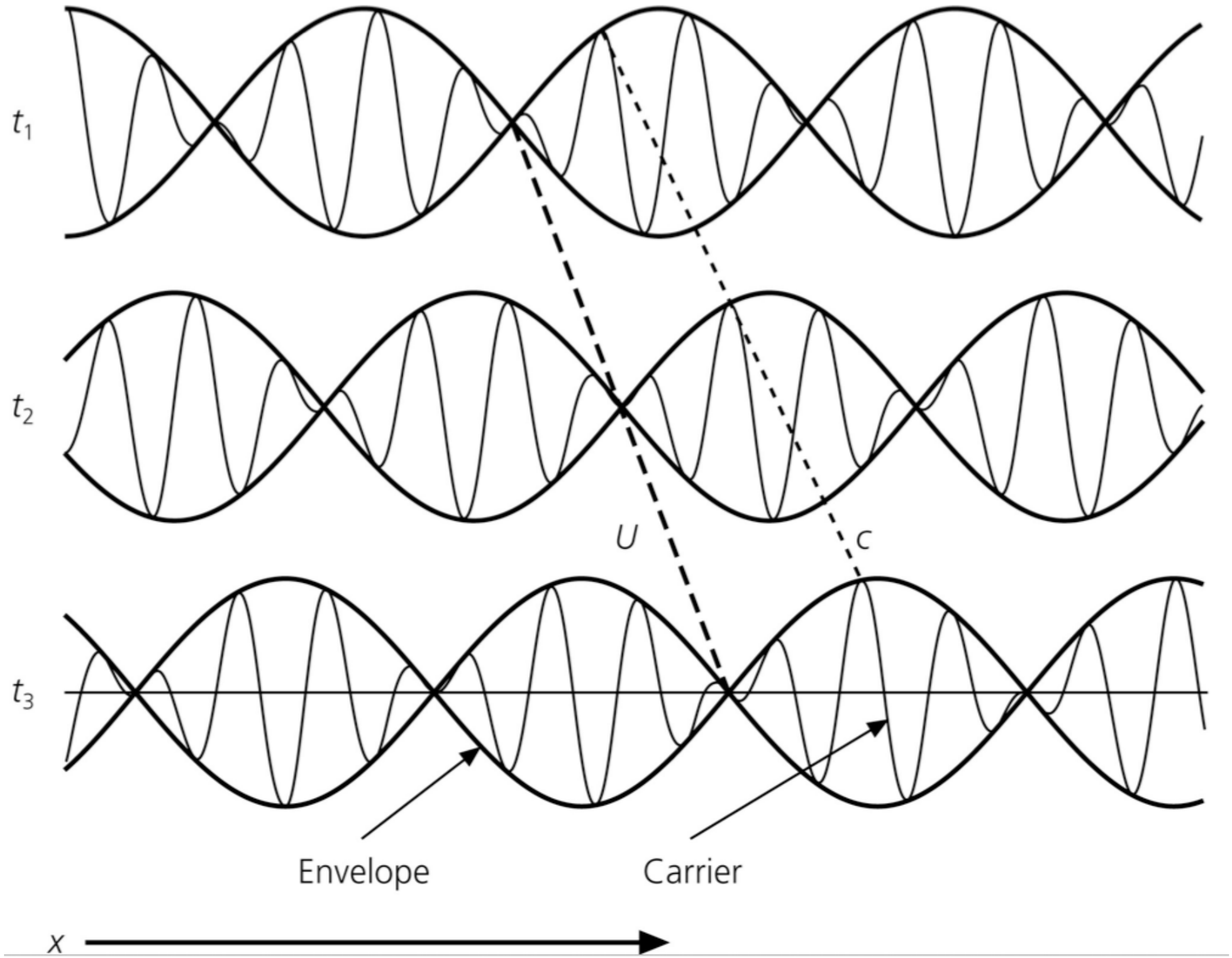




Rayleigh waves

Phase/Group velocity


A
B
A+B

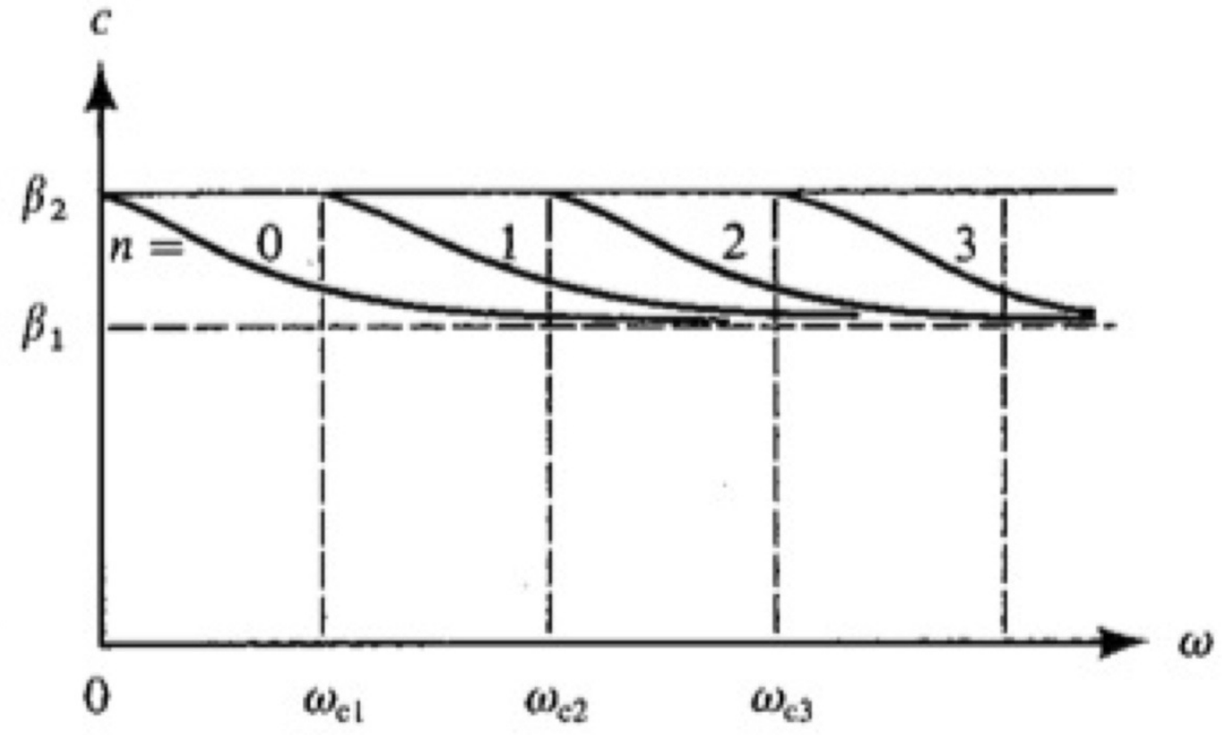

t_1
t_2
t_3
U
c
Envelope
Carrier
x

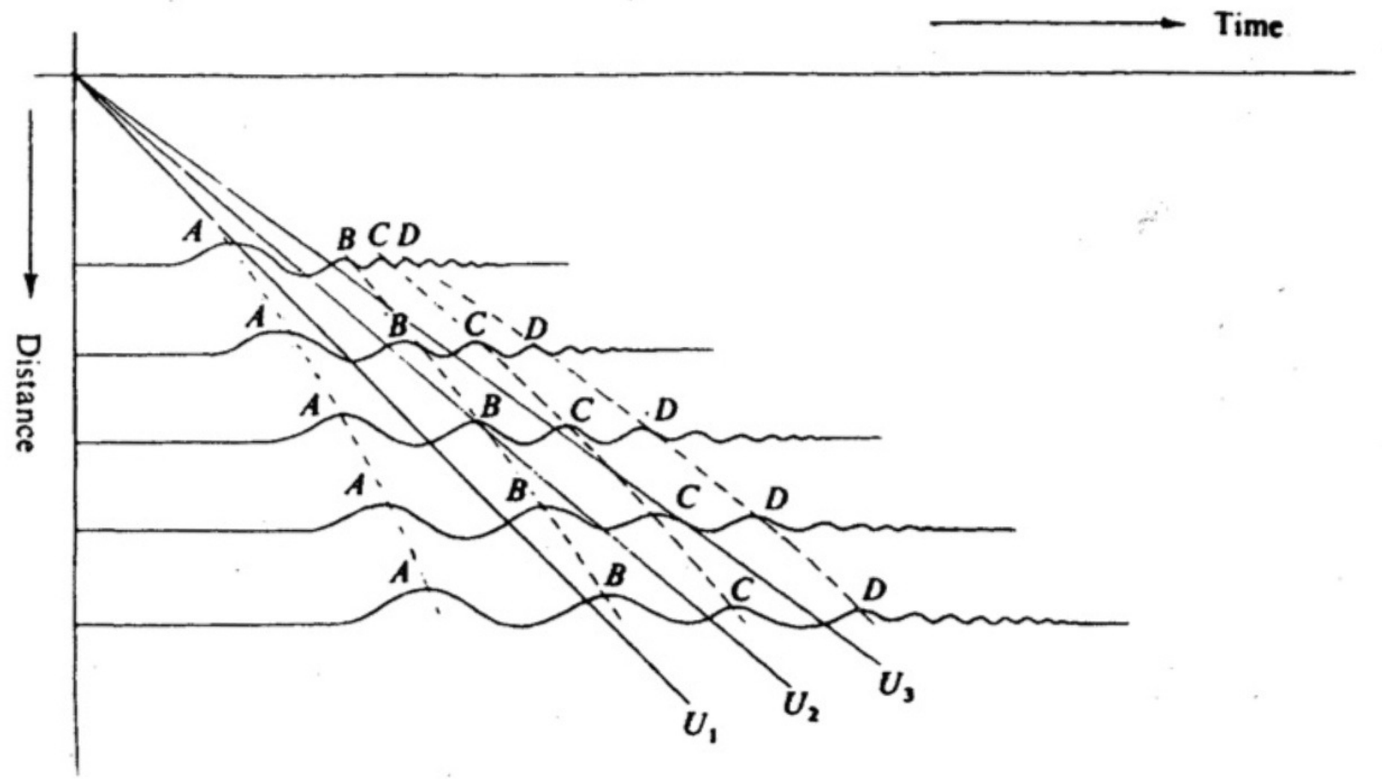
red dot: moves with *phase* velocity

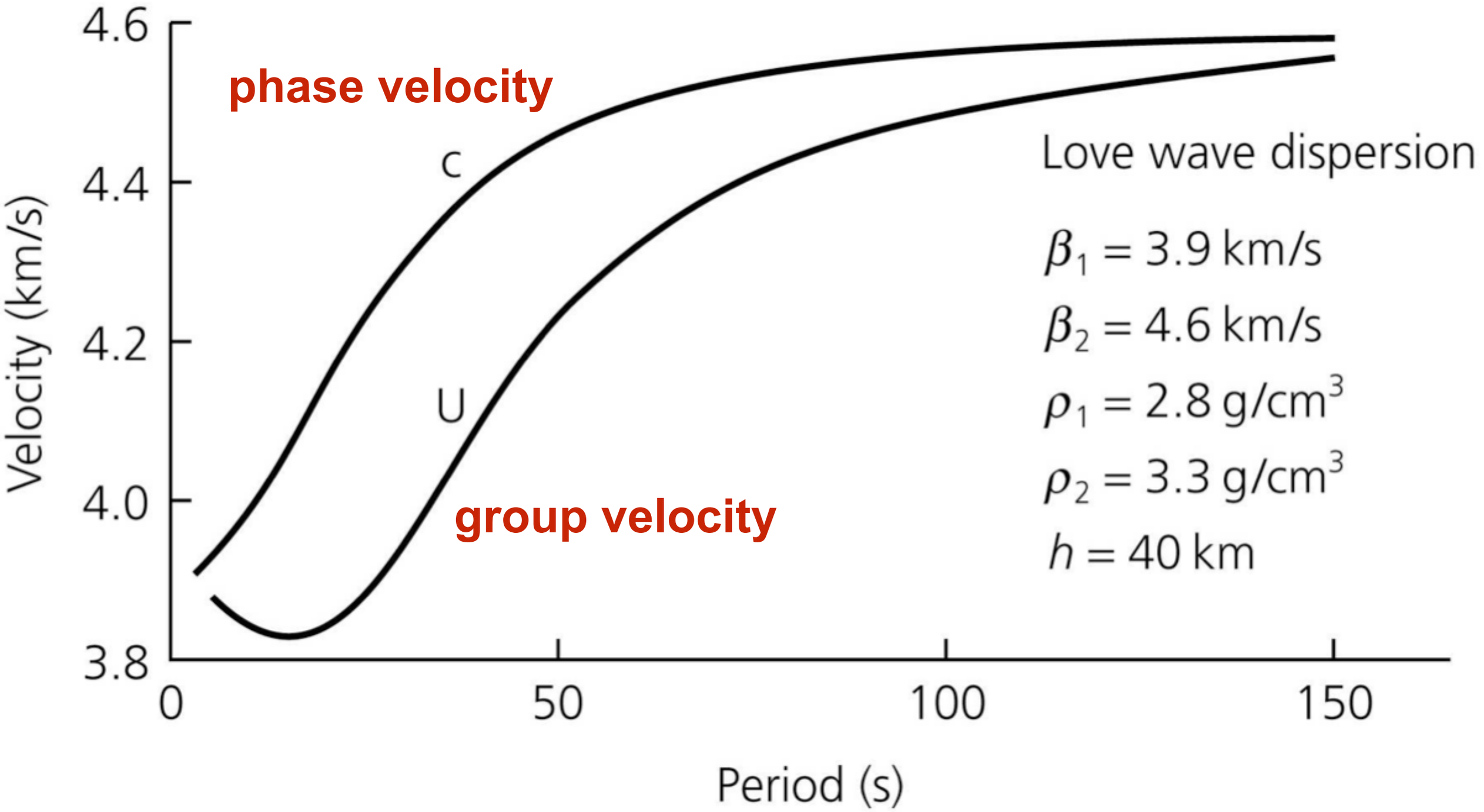
green dot: moves with *group* velocity

Surface wave dispersion

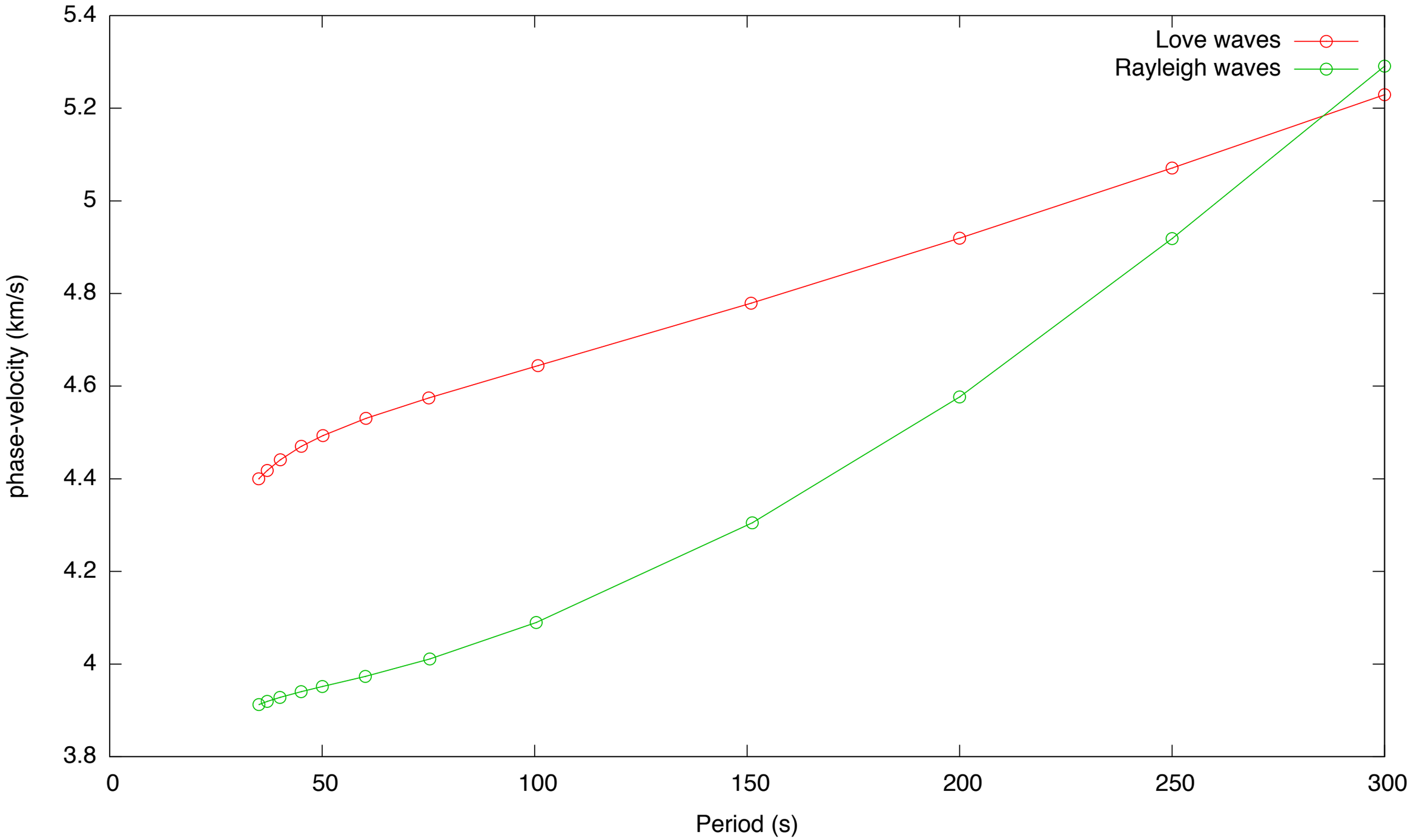
Dispersion


c
β_2
β_1
n =
0
1
2
3
0
ω_{c1}
ω_{c2}
ω_{c3}
ω

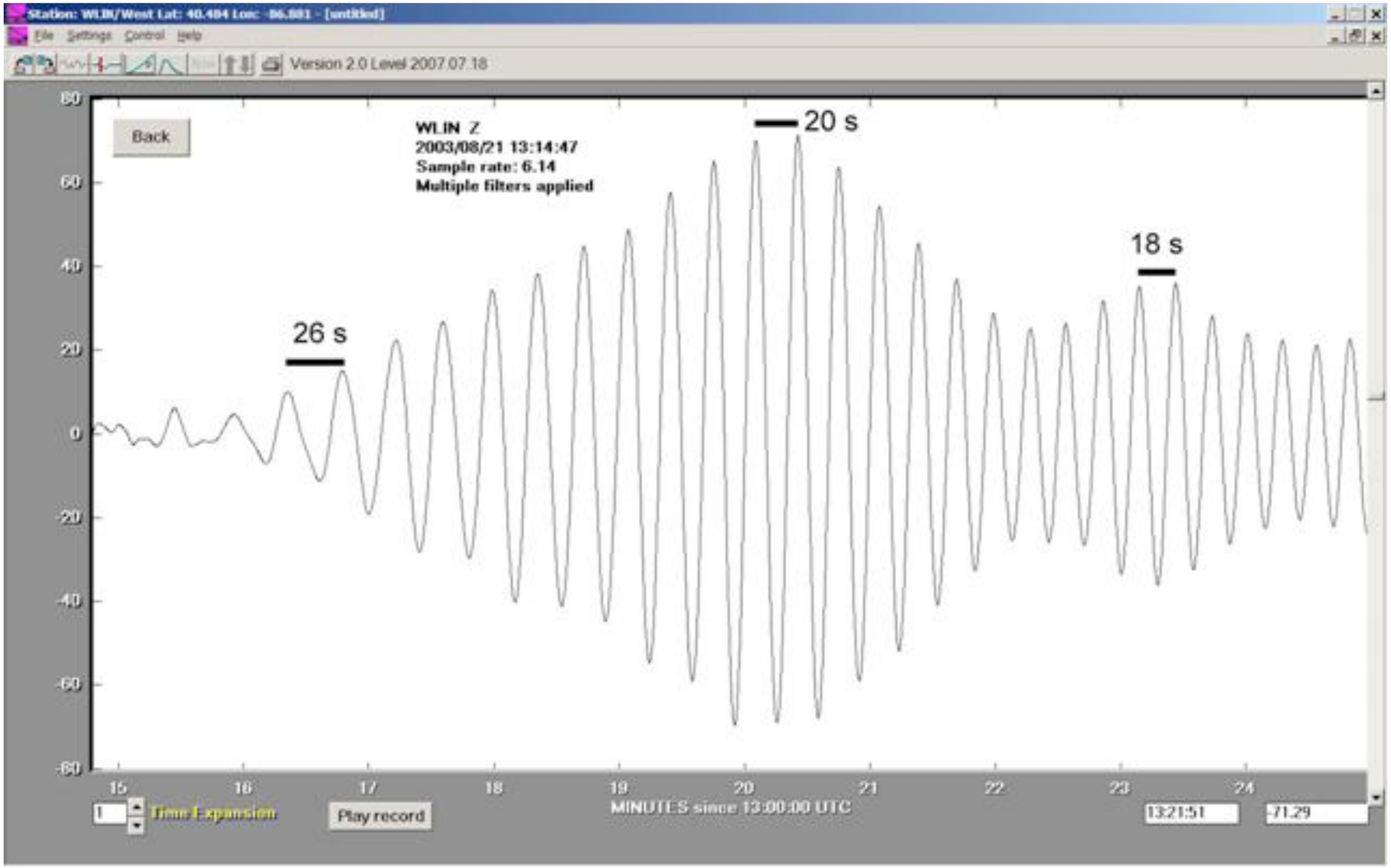

Time
Distance
A
B C D
U_1
U_2
U_3



Dispersion in a layer-over-halfspace model



measured average phase-velocity dispersion for Love & Rayleigh waves



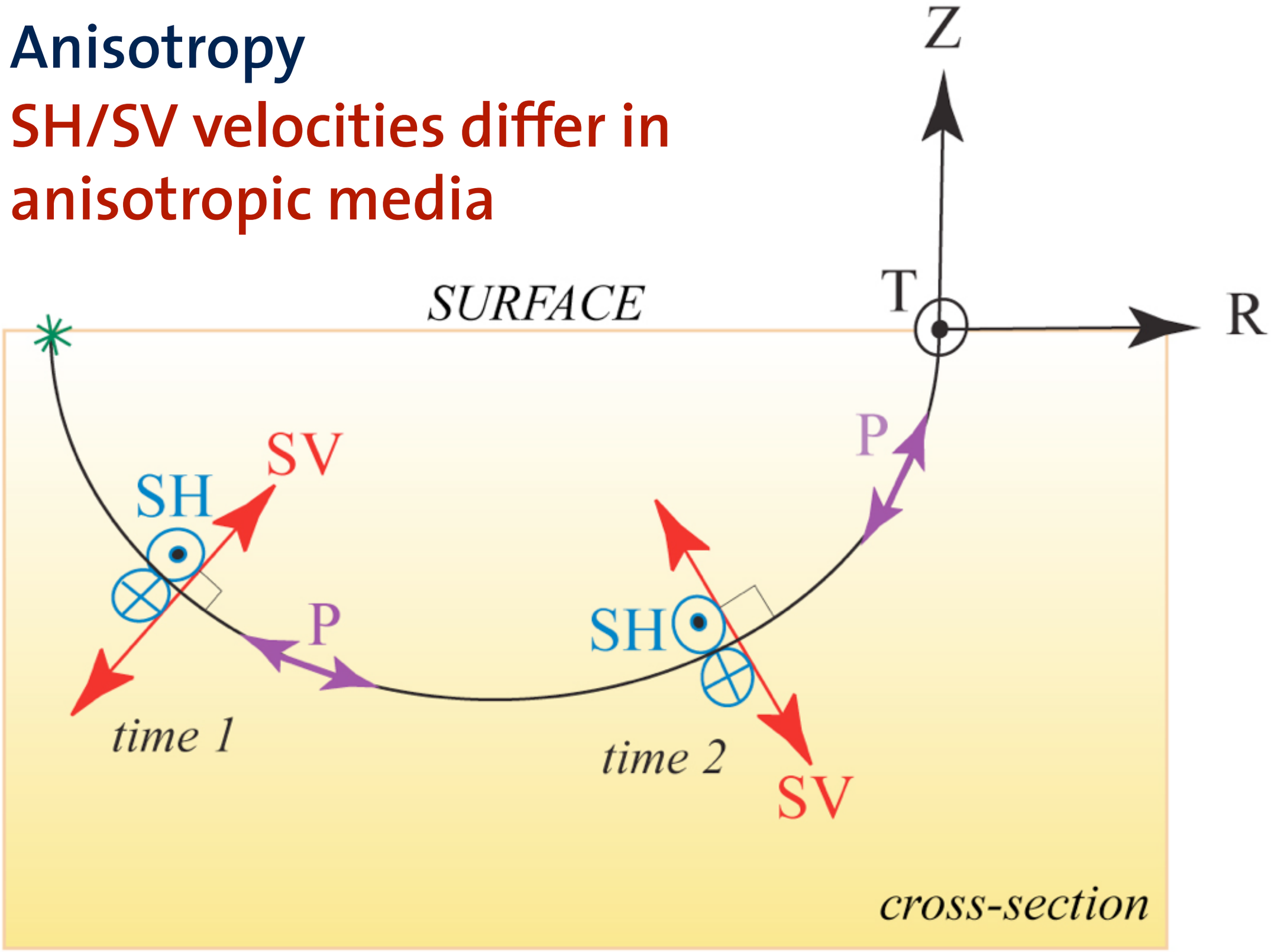
Surface waves from the August 21, 2003 New Zealand earthquake recorded on the WLIN AS-1 seismograph.

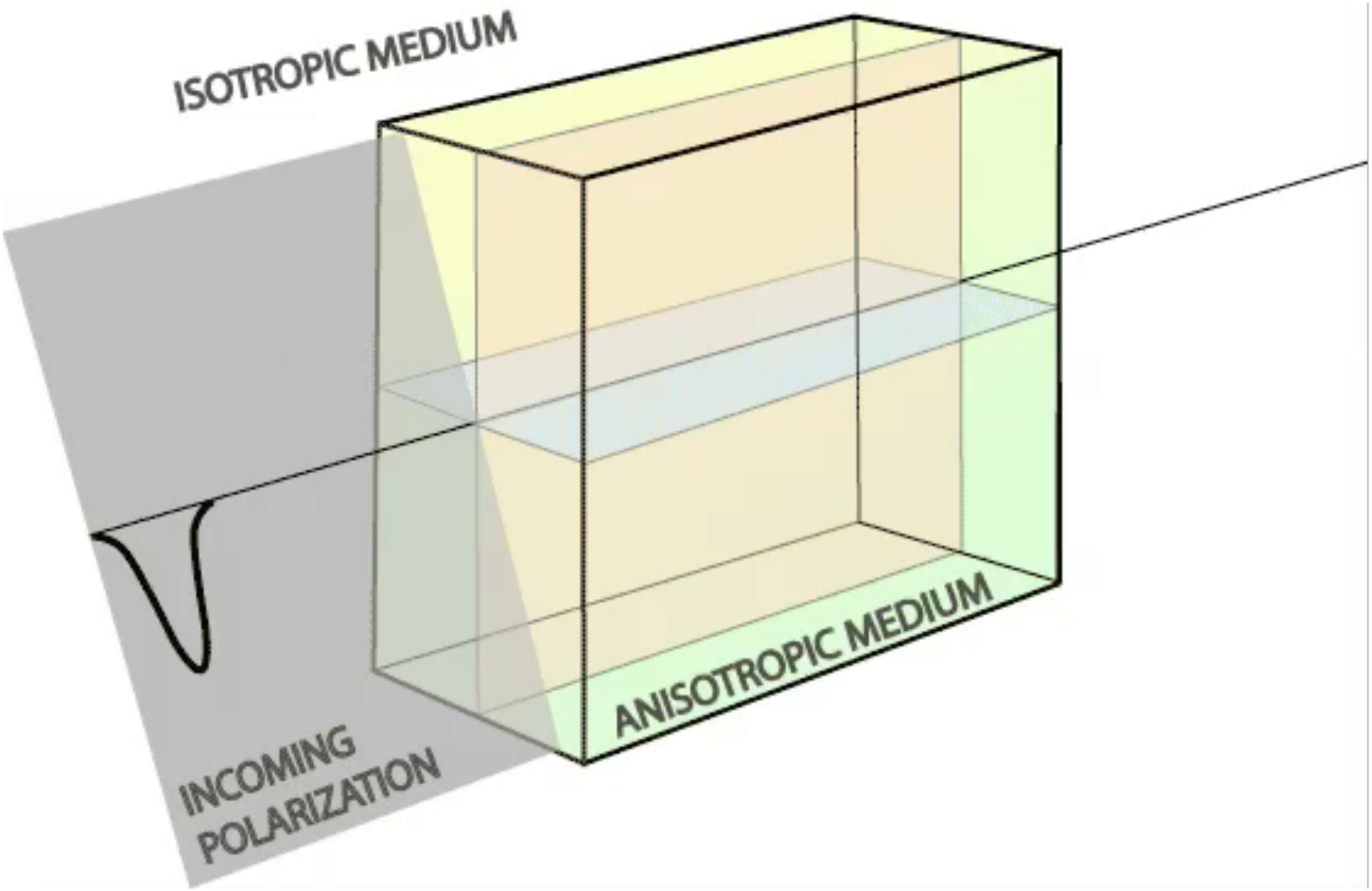
The seismogram has been filtered twice with a low-pass filter (0.1 Hz cutoff frequency) to enhance the surface wave energy

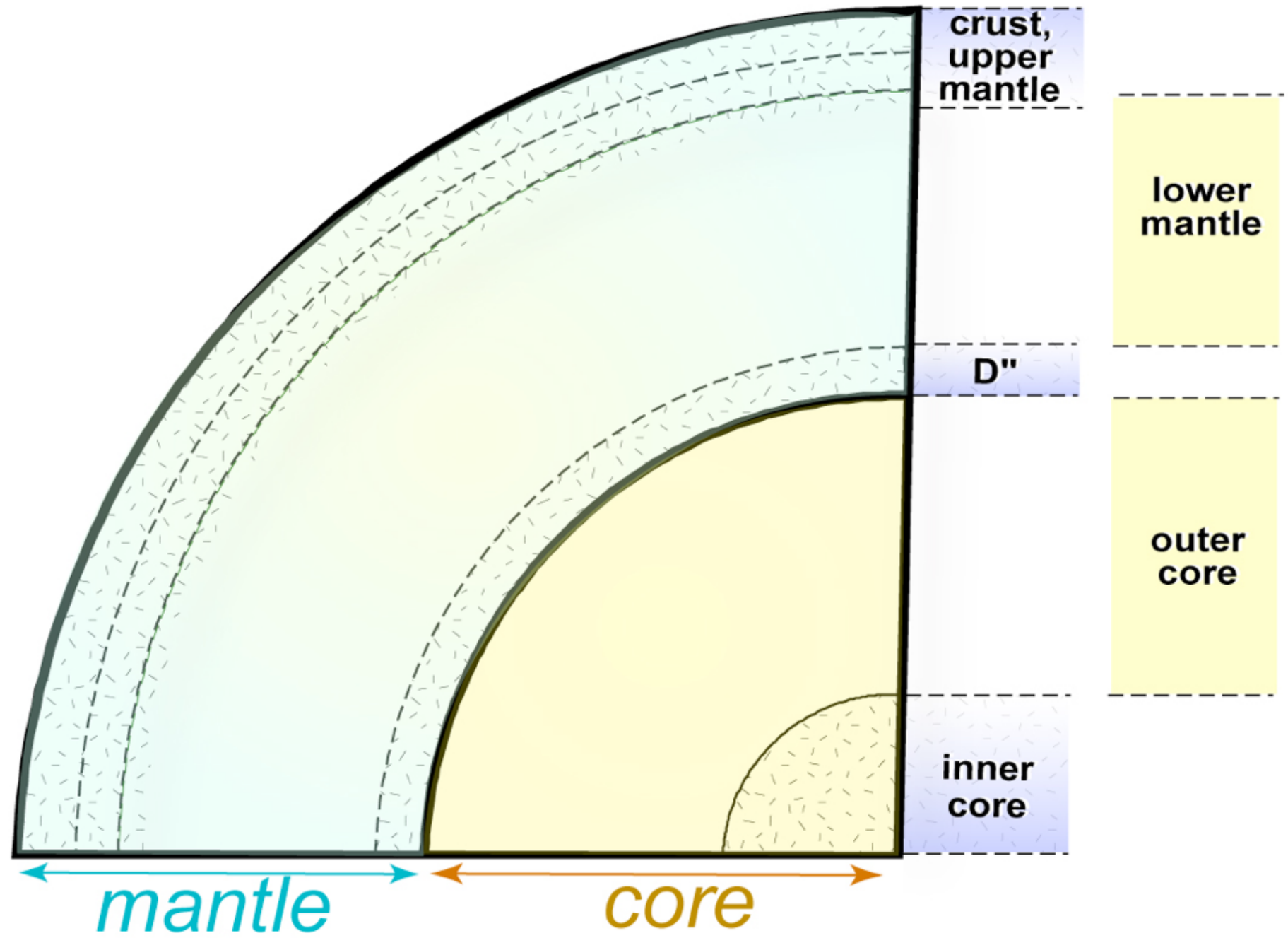
Anisotropy

Anisotropy

SH/SV velocities differ in anisotropic media




ISOTROPIC MEDIUM
INCOMING
POLARIZATION
ANISOTROPIC MEDIUM

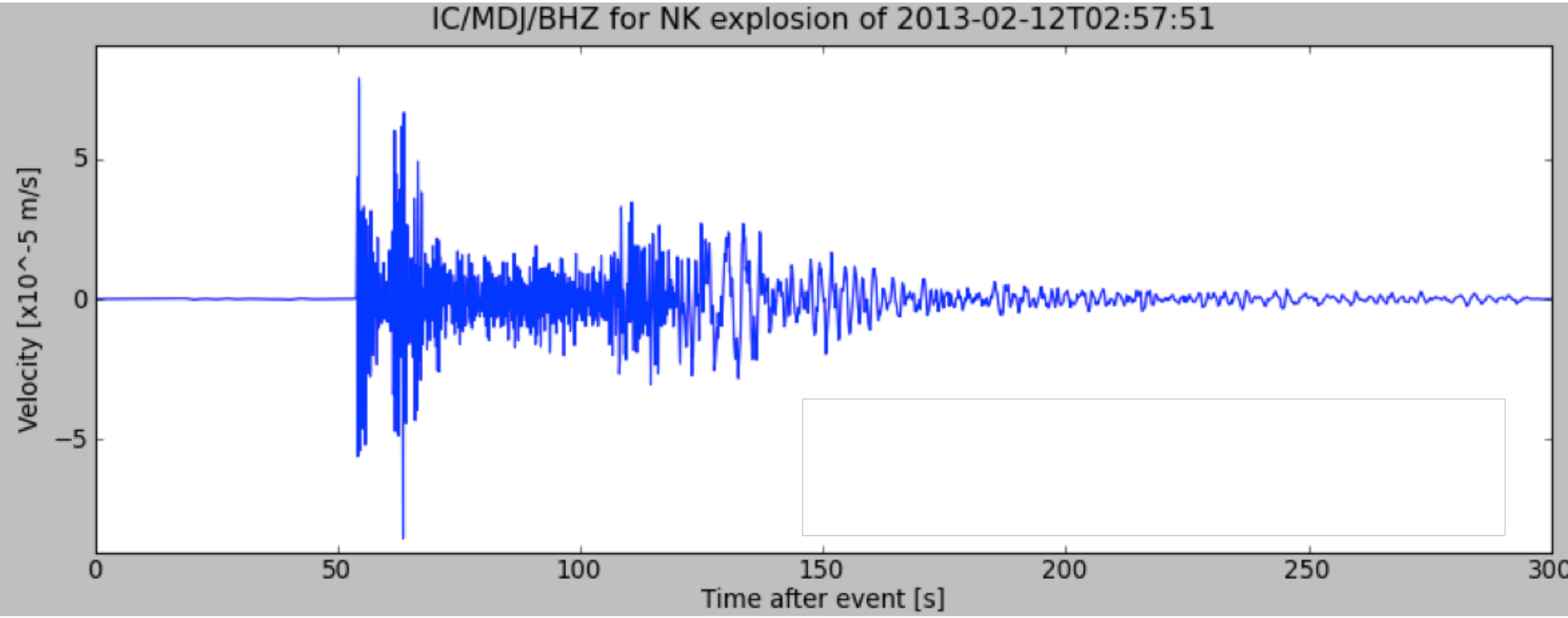

Seismic anisotropy detected/inferred?
YES:
NO:
crust, upper mantle
lower mantle
D"
outer core
inner core
mantle
core

Event discrimination

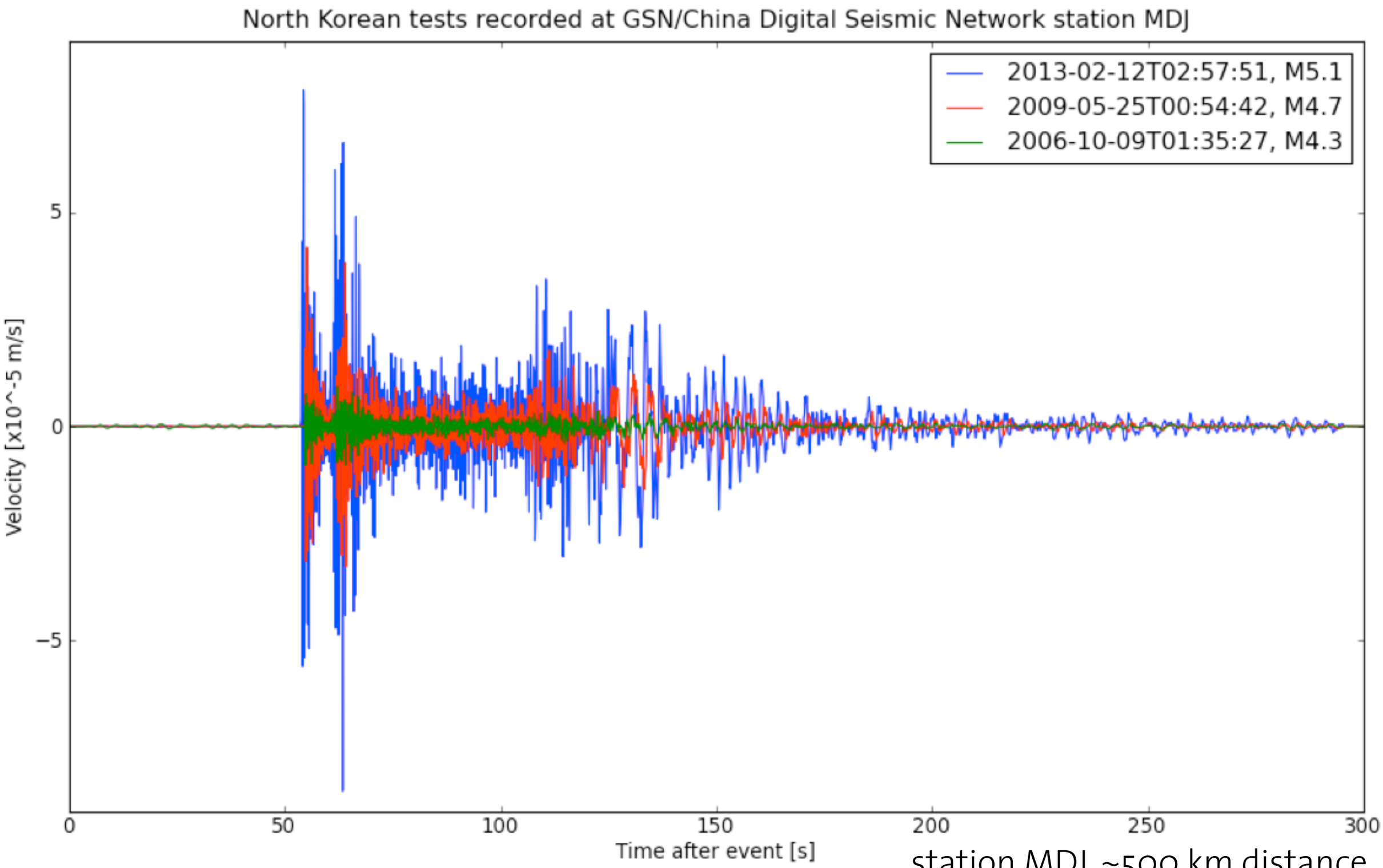
M 5.1 North Korea Seismic Event
12 February 2013 02:57:51

Seismic waves

M 5.1 North Korea Seismic Event
12 February 2013 02:57:51

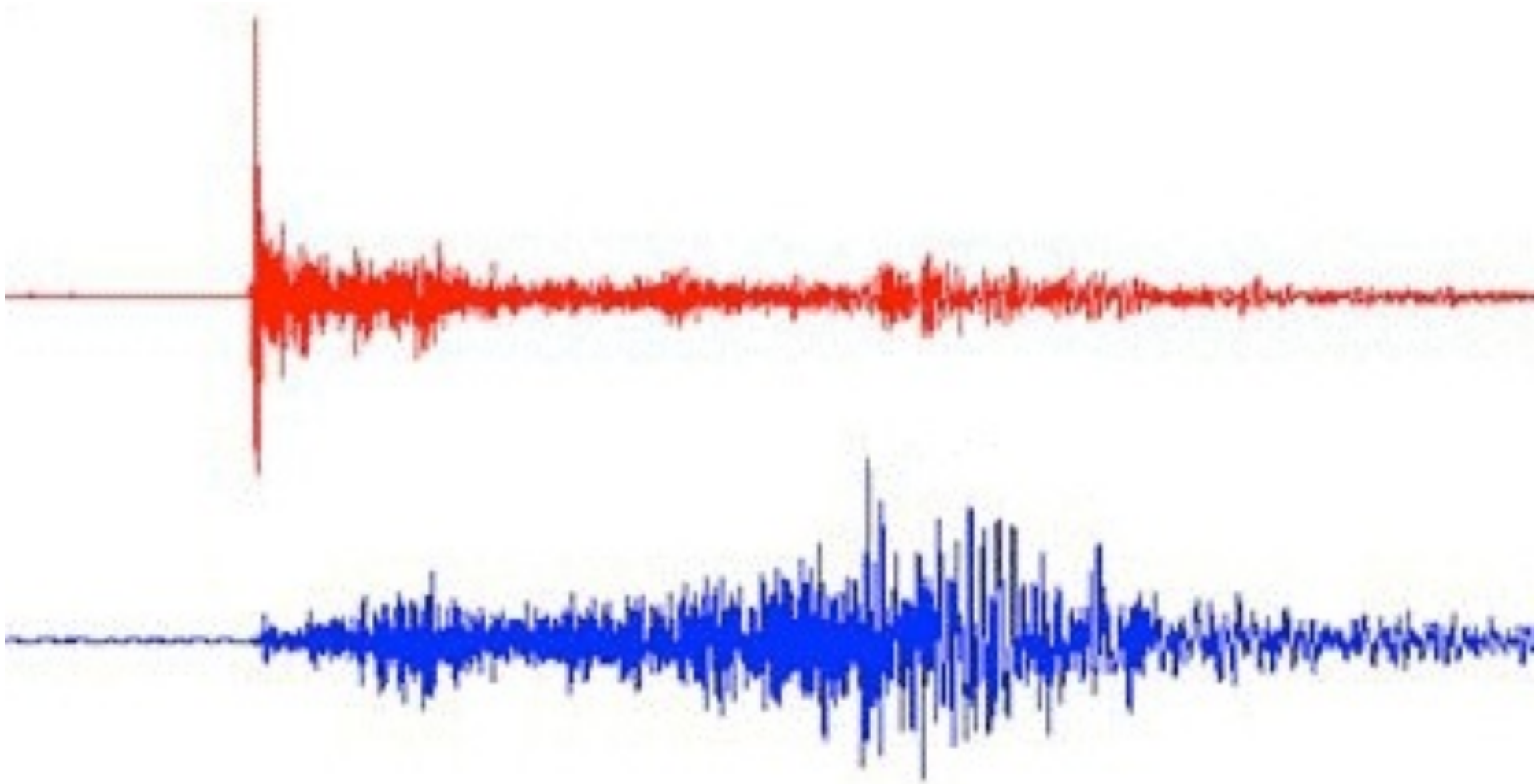


station MDJ, ~500 km distance



station MDJ, ~500 km distance

recordings nuclear tests



recordings nuclear tests