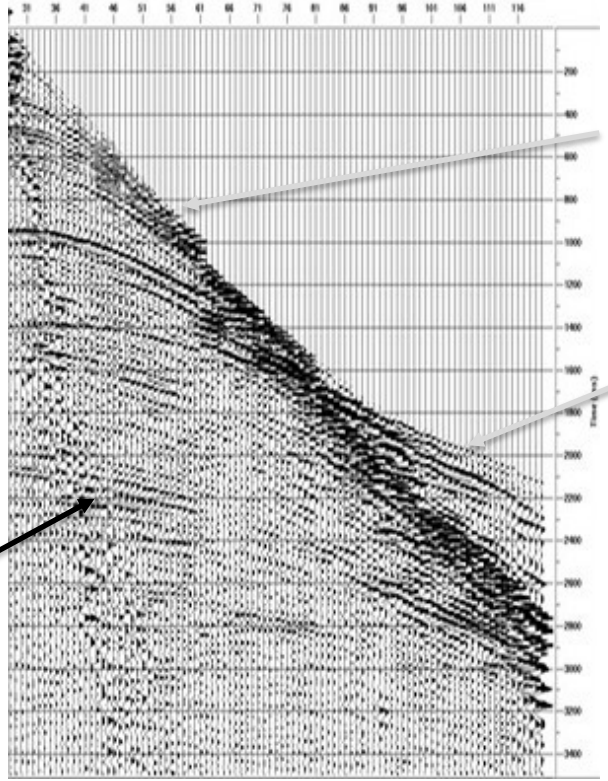
11. Reflection Seismology

M. Ravasi

ERSE 210 Seismology

Seismic recordings



Direct wave

Refracted waves

Reflected waves

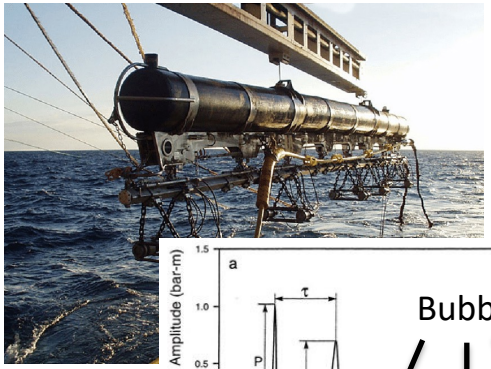
Seismic propagation movie

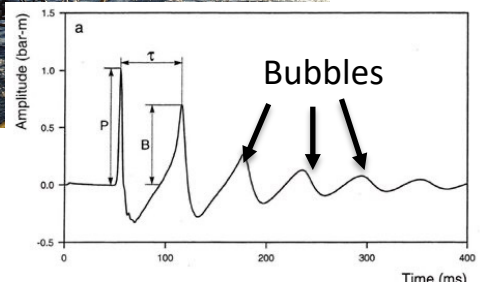
Make video of wave propagation in Marmousi

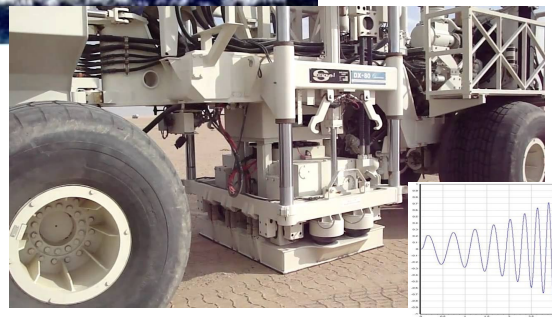
Seismic sources

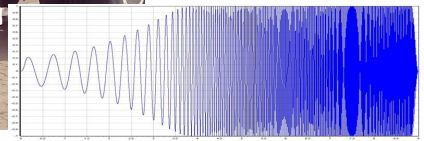
Dynamite

Airgun









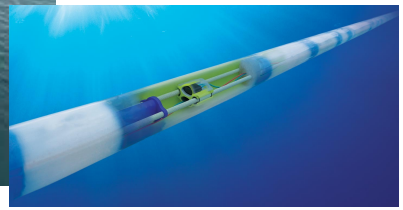
Sweep
(chirp)

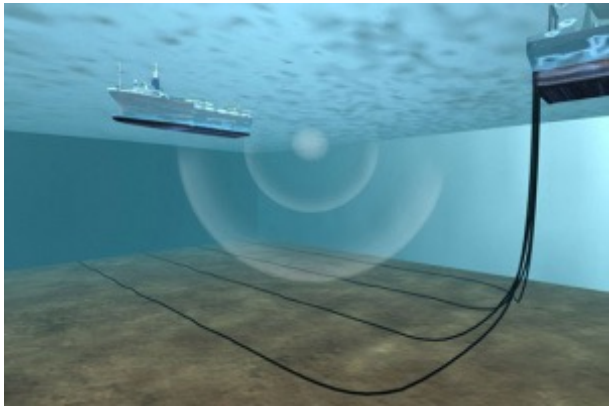
Vibroseis

Seismic receivers

Geophones

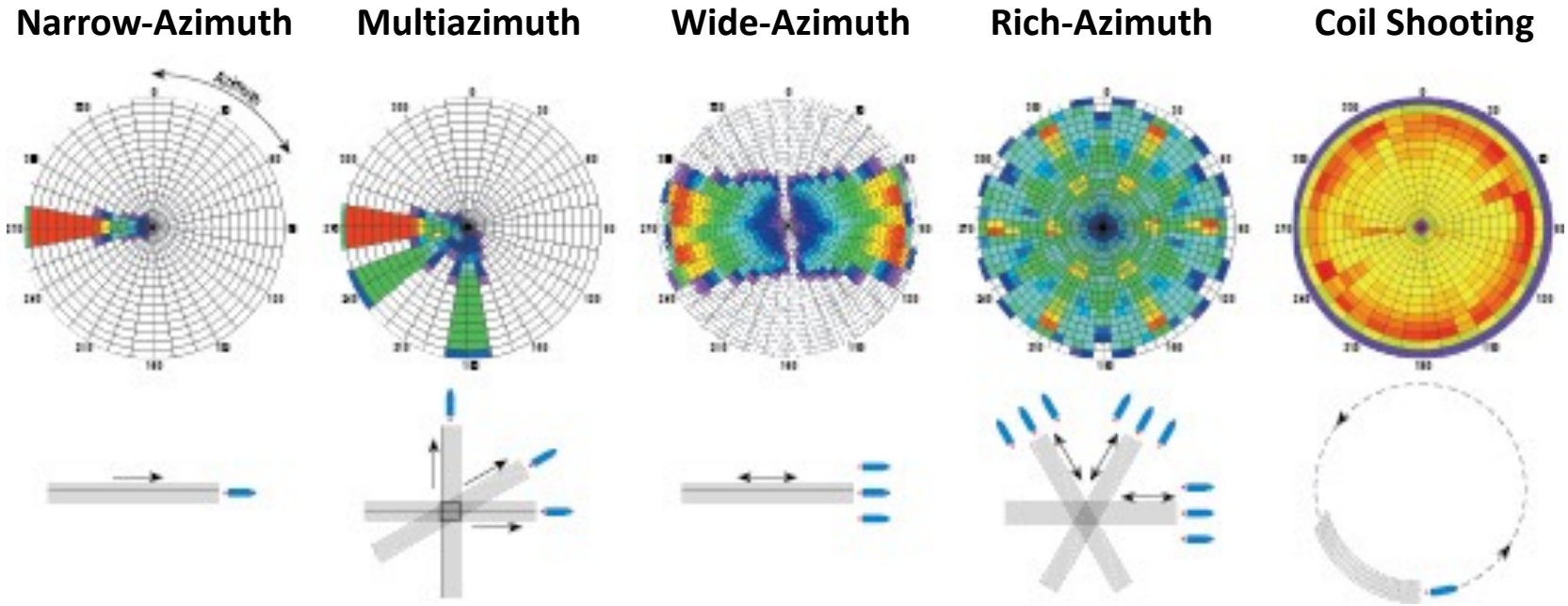
Streamer



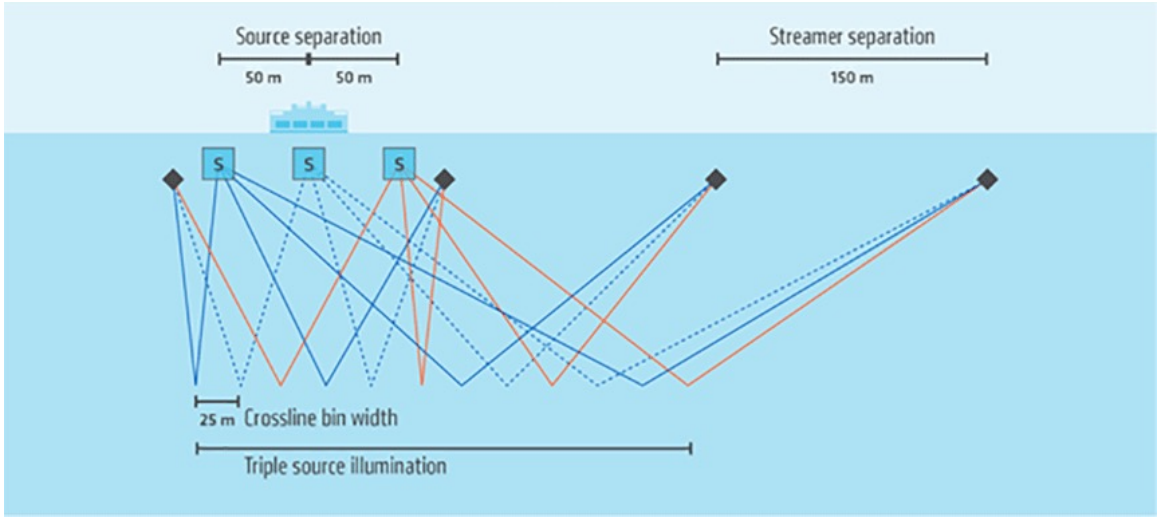


OBC

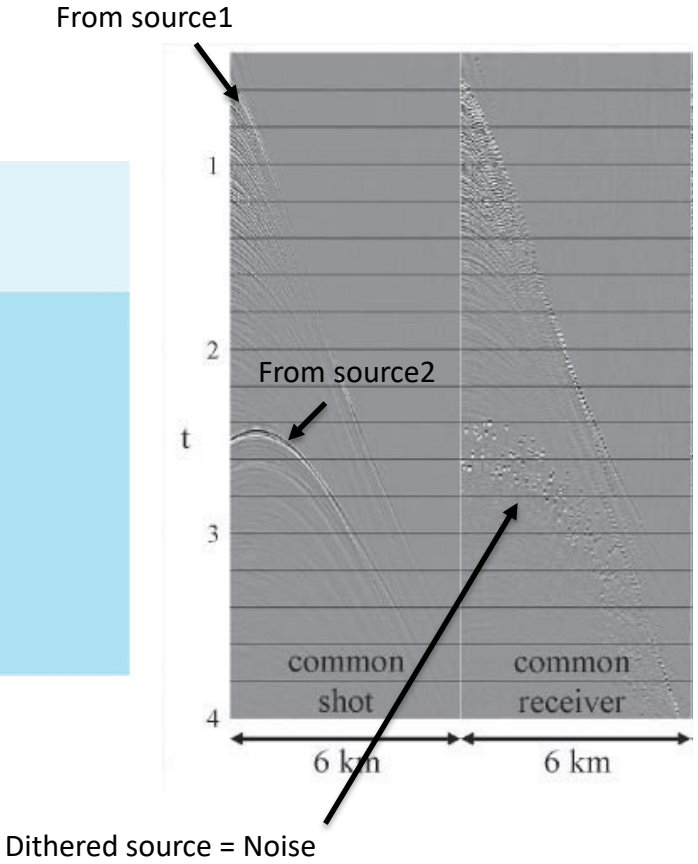
Seismic marine geometries



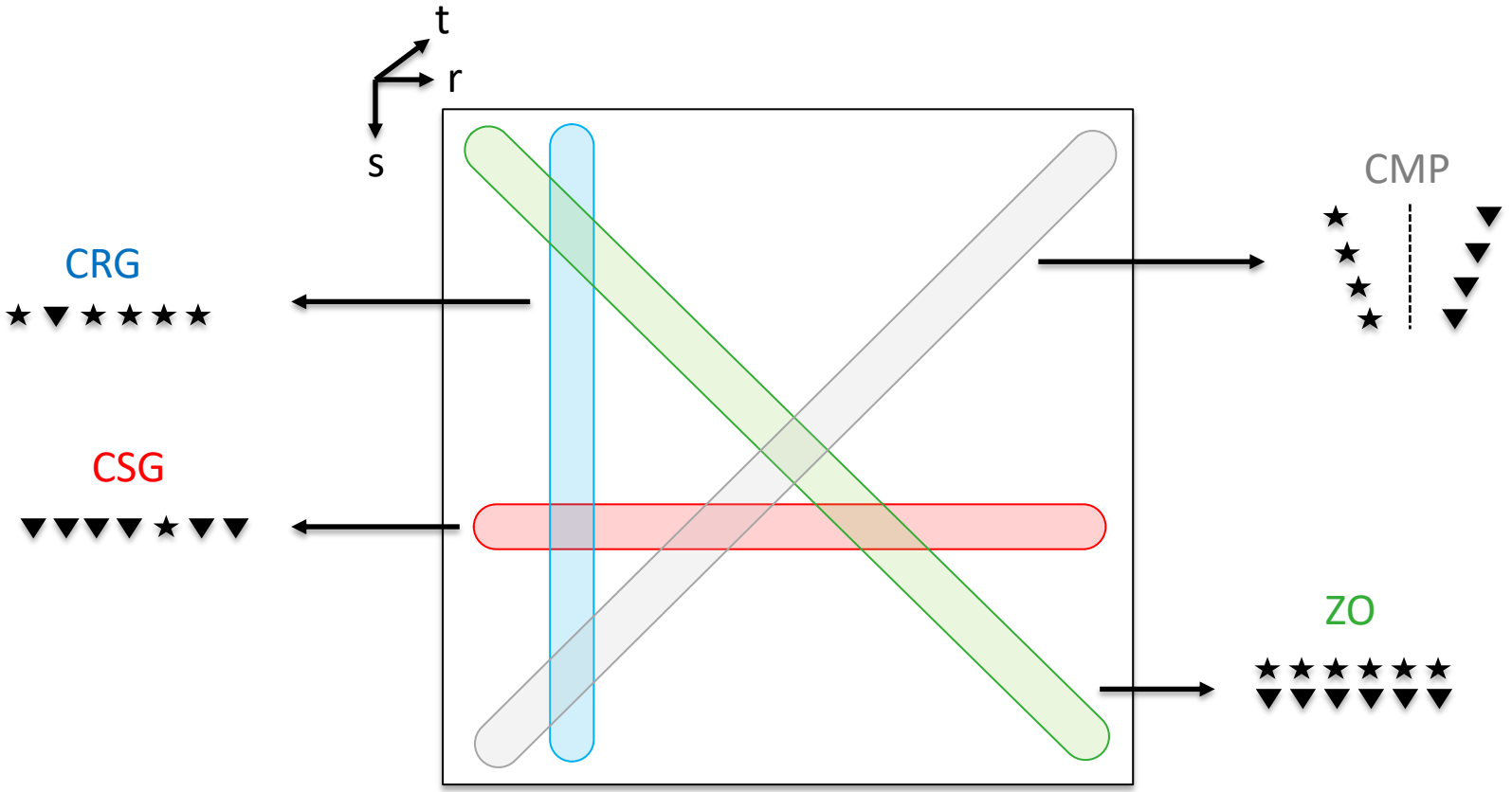
Simultaneous shooting



$$J = \|\mathbf{\Gamma}^H\mathbf{b} - \mathbf{L}\mathbf{m}\|_p + \varepsilon\|\mathbf{m}\|_1$$

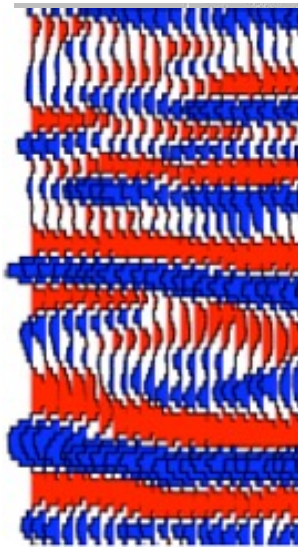


Seismic Data Arrangements

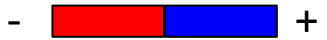


Seismic Data Visualization

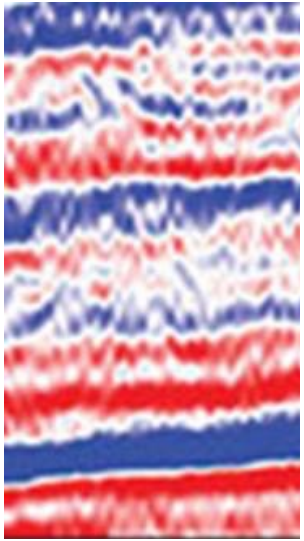
70s / 80s



90s

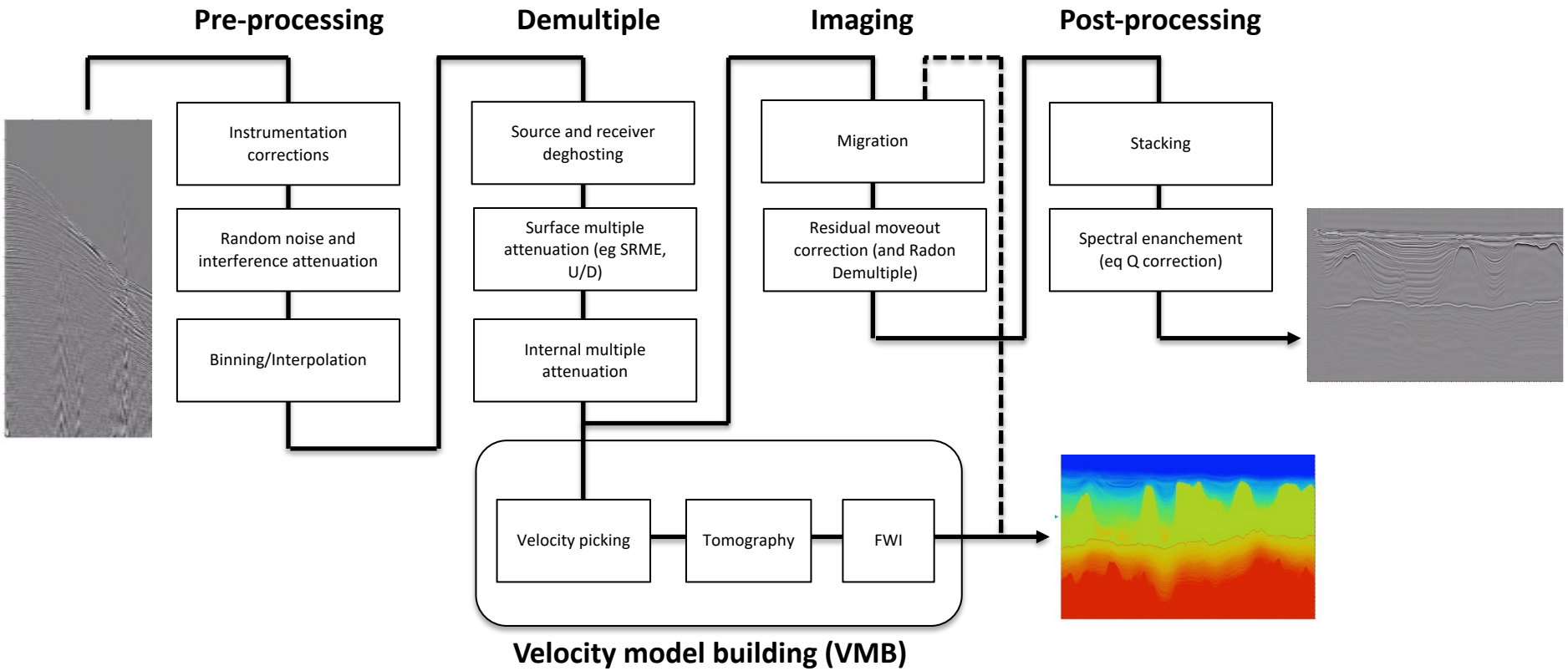


SEG Convention

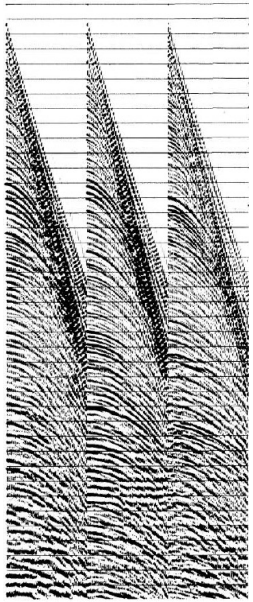


2000s

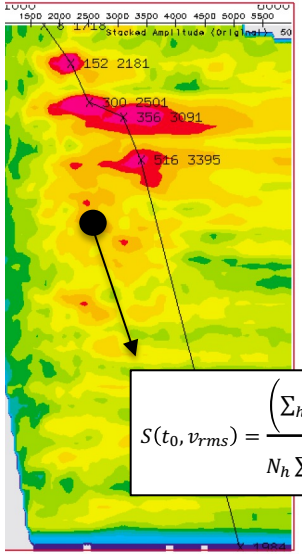
Seismic Processing flow



NMO Analysis

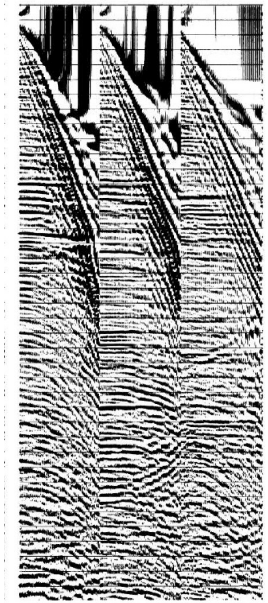


Velocity analysis



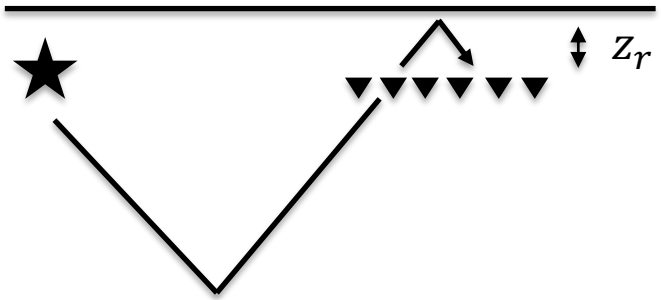
$$S(t_0, v_{rms}) = \frac{\left(\sum_h d\left(t = \sqrt{t_0^2 + h^2/v_{rms}^2}, h\right)\right)^2}{N_h \sum_h d^2\left(t = \sqrt{t_0^2 + h^2/v_{rms}^2}, h\right)}$$

NMO Correction



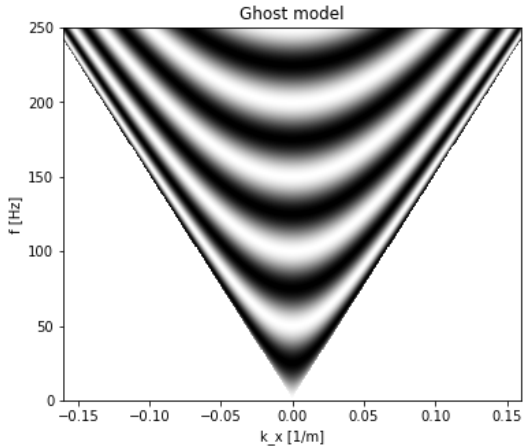
* Figures from Yilmaz book

Deghosting

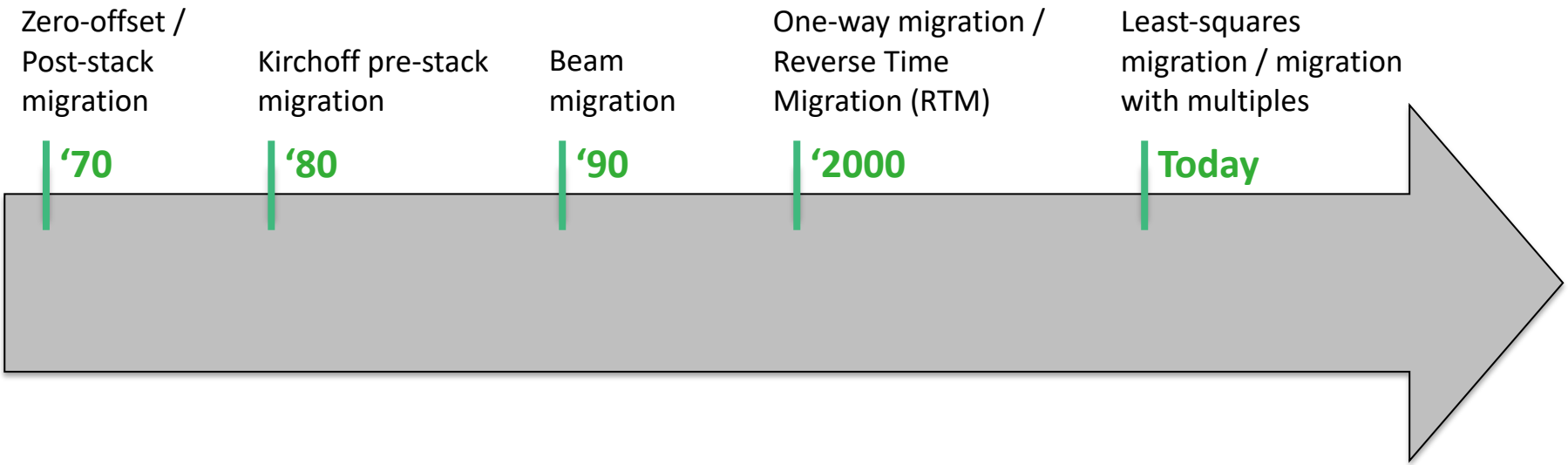


$$d(t,\theta) = d_p(t,\theta) - d_p\left(t - \frac{2z_r cos\theta}{v_{water}}\right)$$

$$D(f,k_x) = D_p(f,k_x)\left[1 - e^{-j2\pi k_z(2z_r)}\right]$$

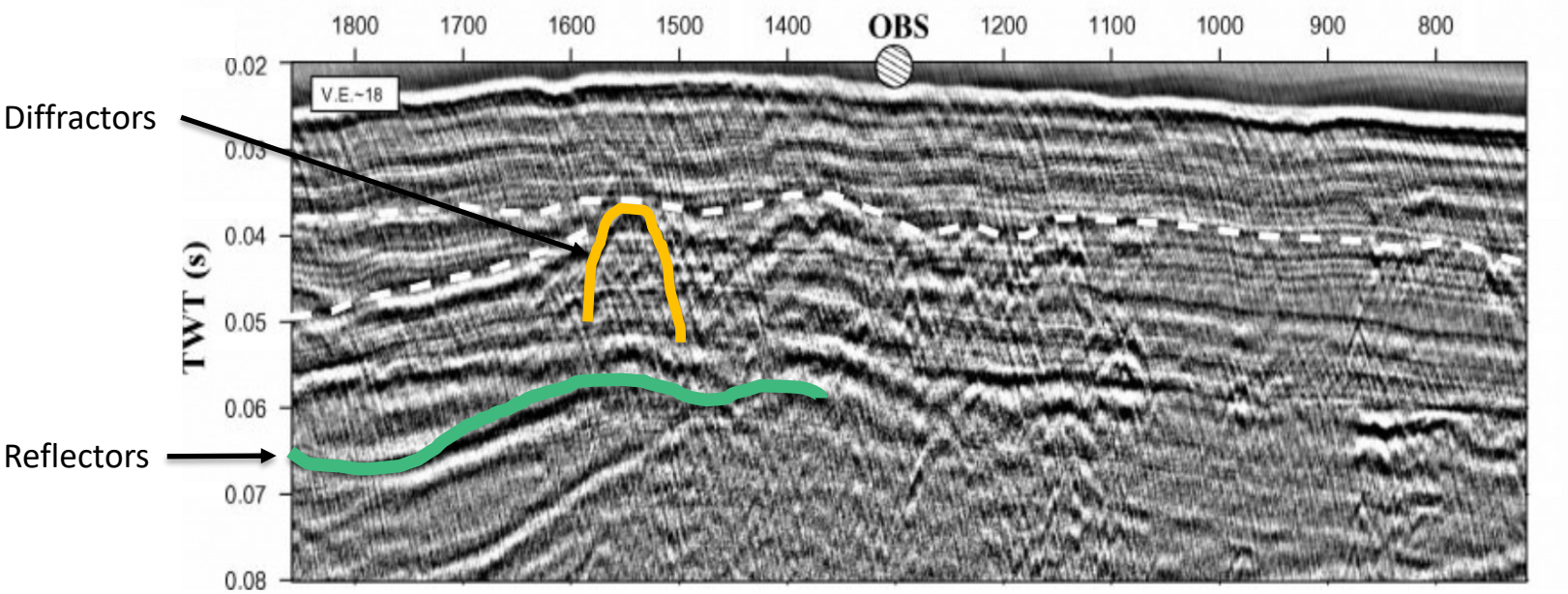


Migration

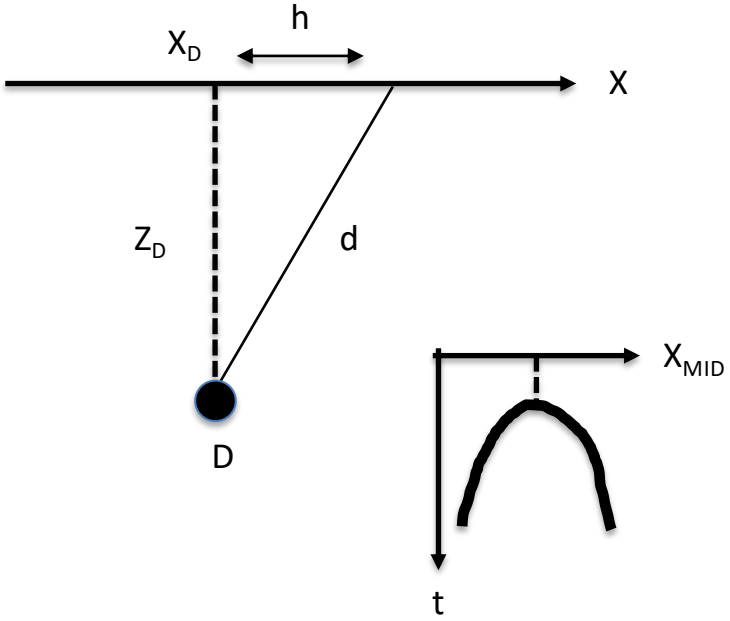


* This is a timeline of industry adoption (most theories have been developed some 20 years before the method becomes practical for real applications

Zero-offset seismic sections



Diffraction hyperbolas



$$t(x_{MID}; D) = \sqrt{t_0^2 + \frac{4h^2}{v^2}}$$

$$t_0 = \frac{2z_D}{v}$$