

Reflection seismic 1 script

Educational Material

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Publication date:

2001

Permanent link:

<https://doi.org/10.3929/ethz-a-004363847>

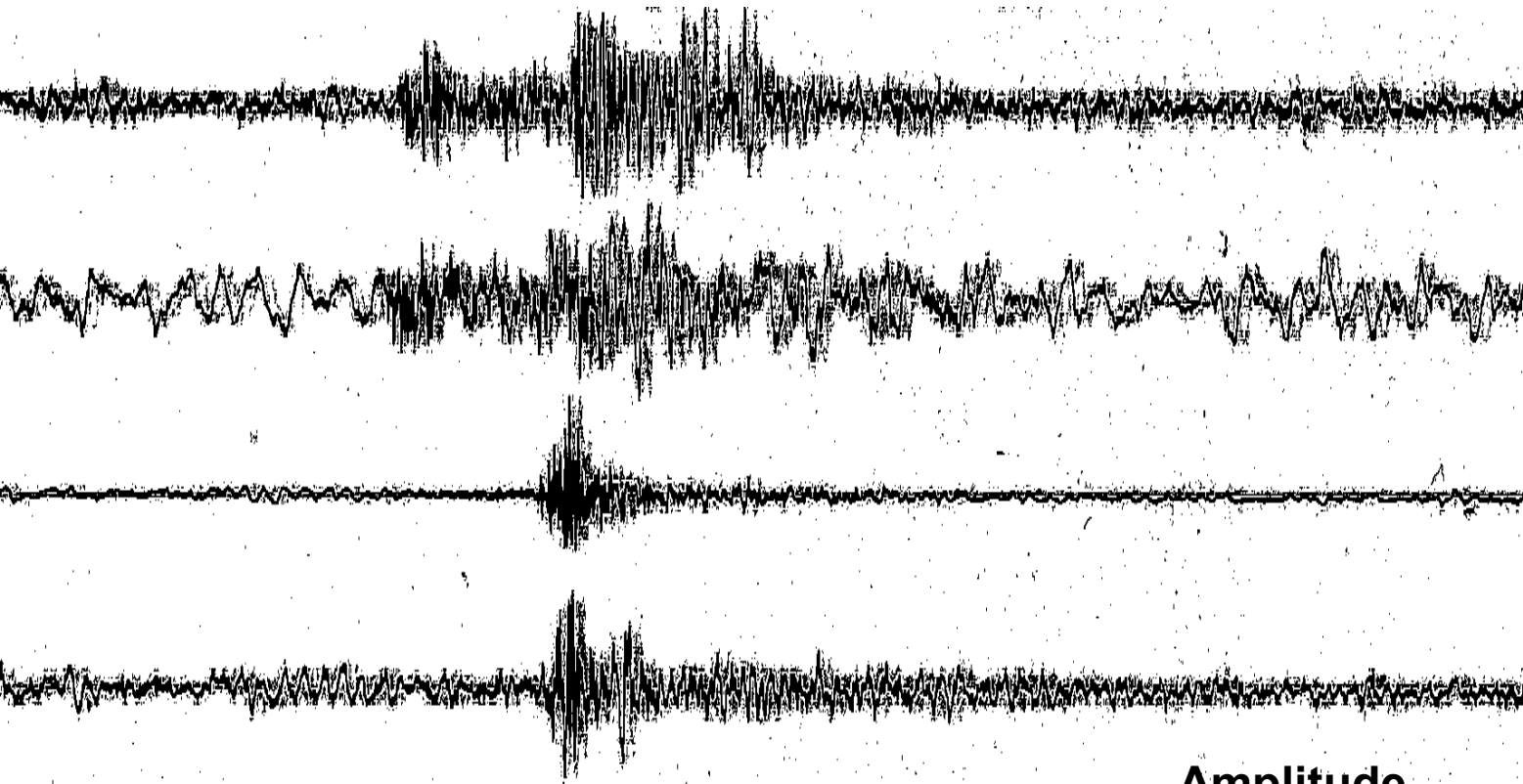
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Seismogram

- Relation between seismic trace and geology
- Multiples
- Resolution
 - Vertical resolution
 - Horizontal resolution

Seismogram of an earthquake



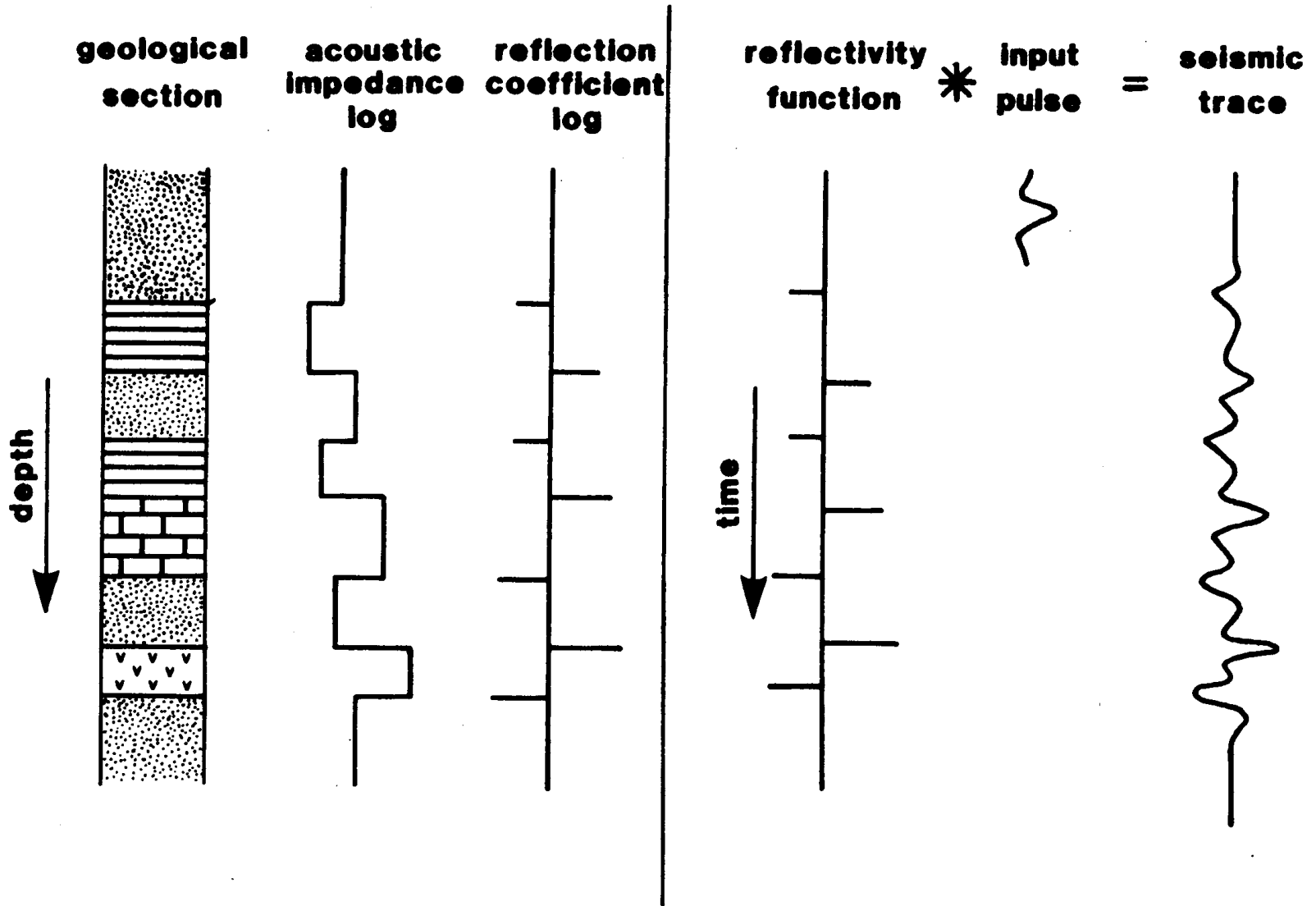
Amplitude



Zeit

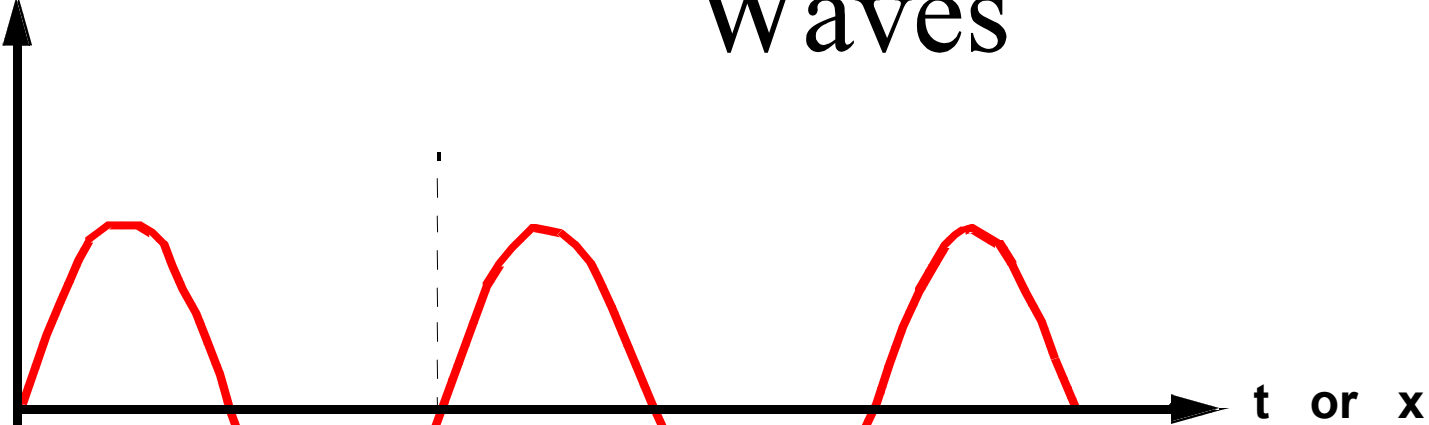


From geology to seismogram



Waves

Amplitude



t or x



Wavelength λ

Period τ

Phase

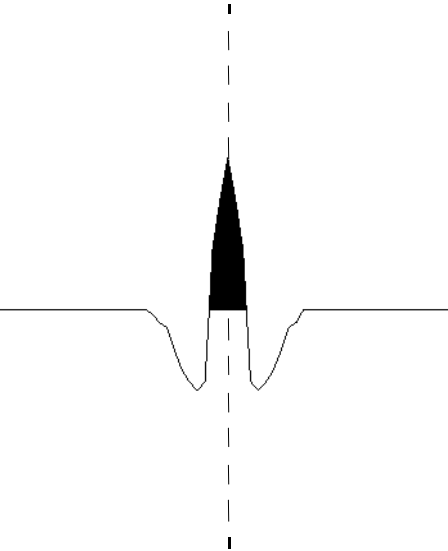
$$\text{Period } \tau = \frac{1}{f} = \frac{2\pi}{\omega}$$

$$\text{Wavenumber } k = \frac{2\pi}{\lambda}$$

$$\text{Velocity } v = f\lambda$$

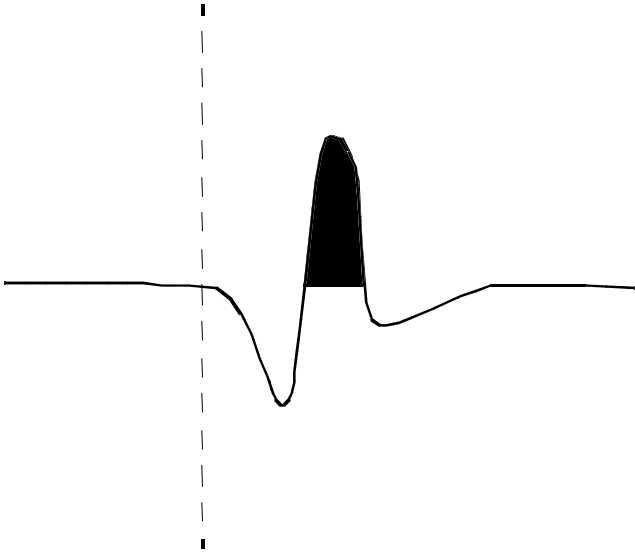
Important wave forms

Zero-Phase



0 time

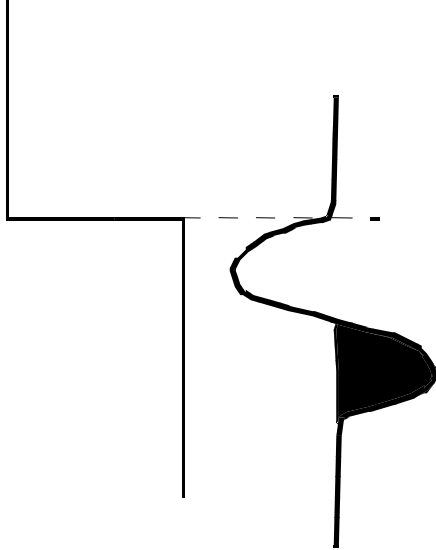
Minimum Phase



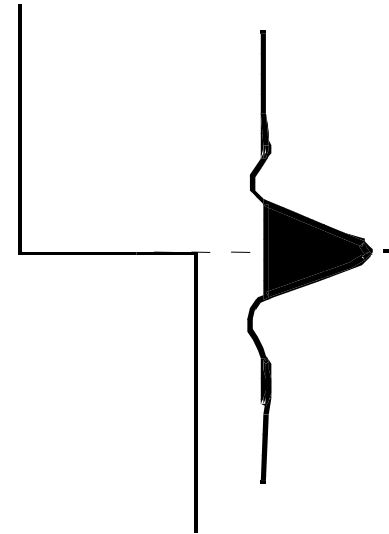
0 time

Minimum phase and zero-phase wavelet

Minimum phase wavelet:



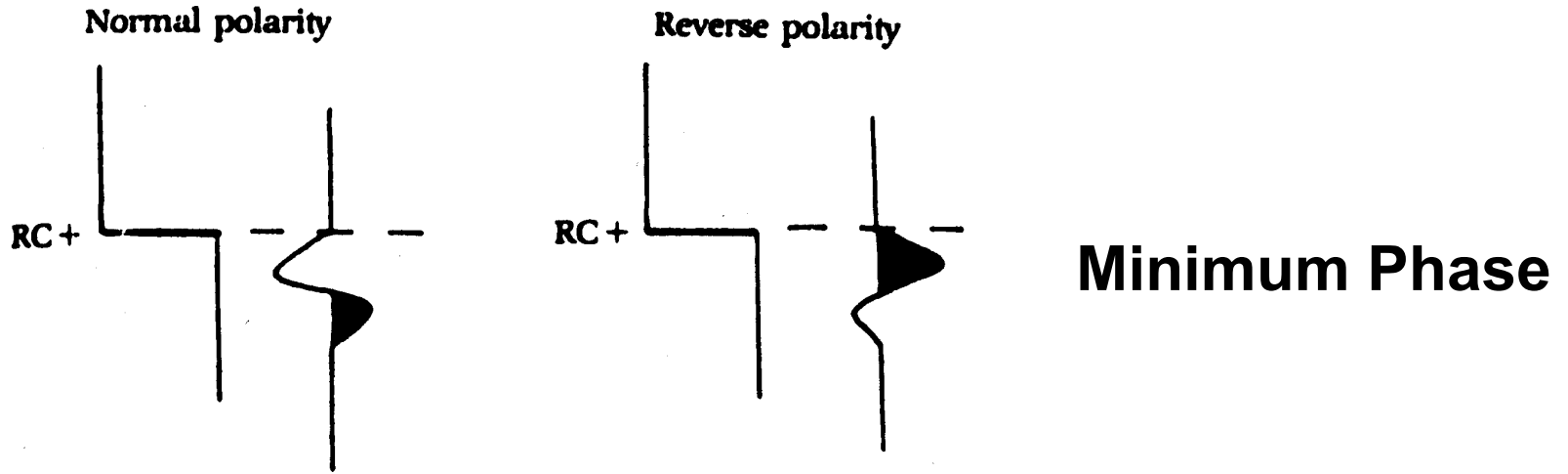
Zero phase wavelet:



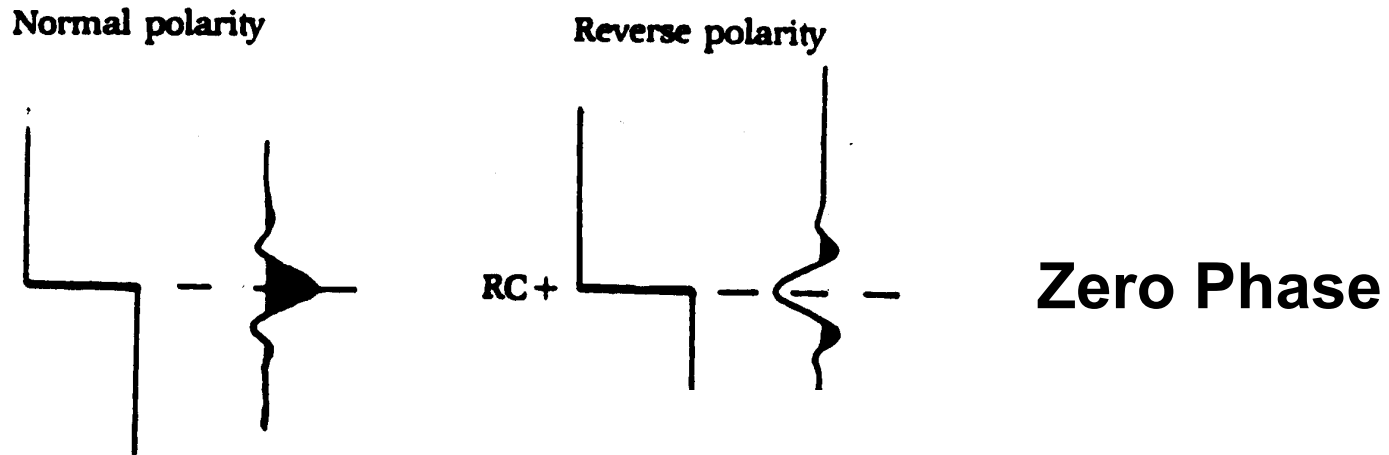
Energy is maximally front-loaded
(Energy does not arrive before zero time)

Symmetric with respect to zero time
and peaks at zero time
(Energy arrives also before zero time)

Important waveforms

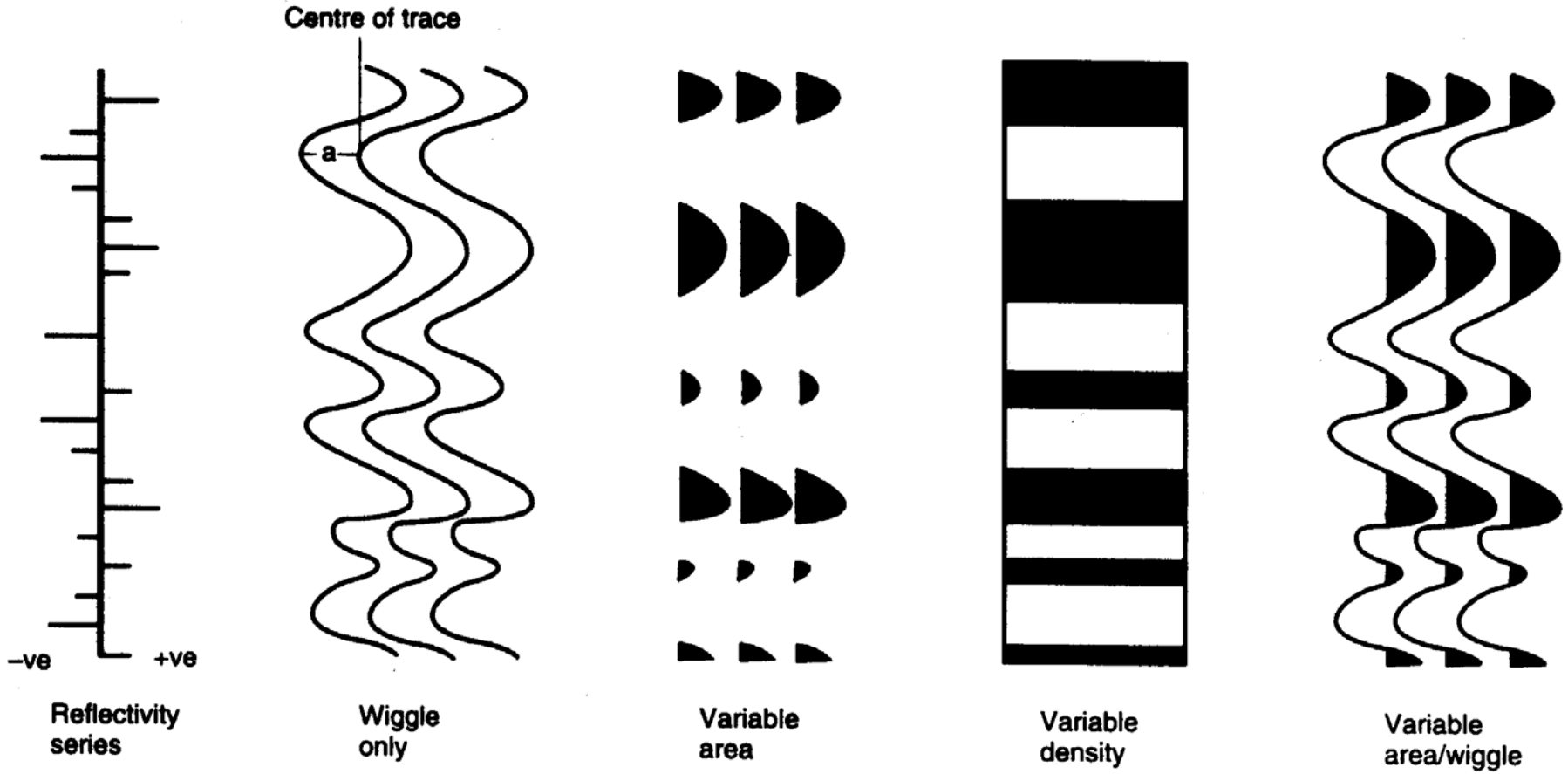


(a)

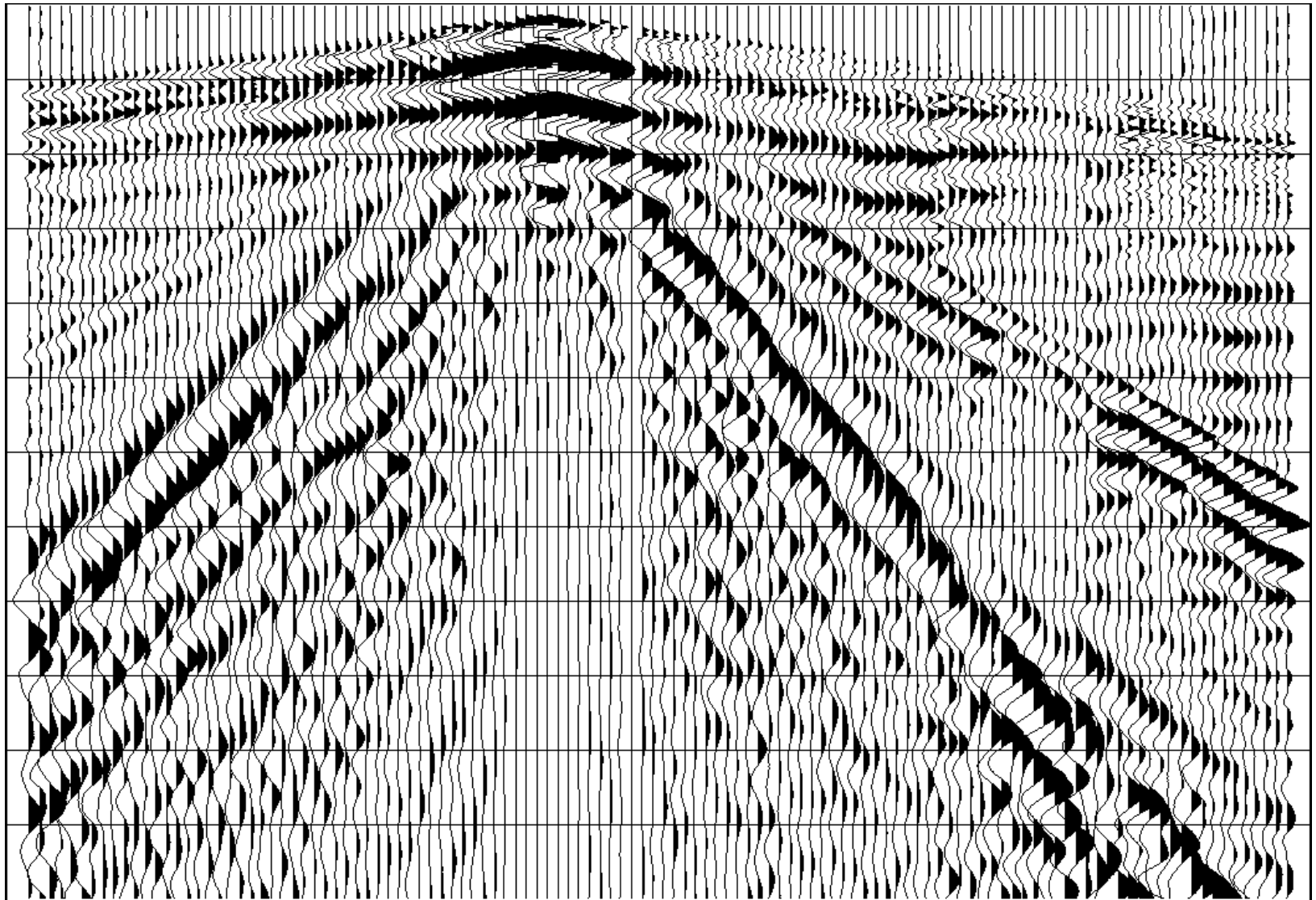


(b)

Display of Seismogram



Example of a shot



Multiples

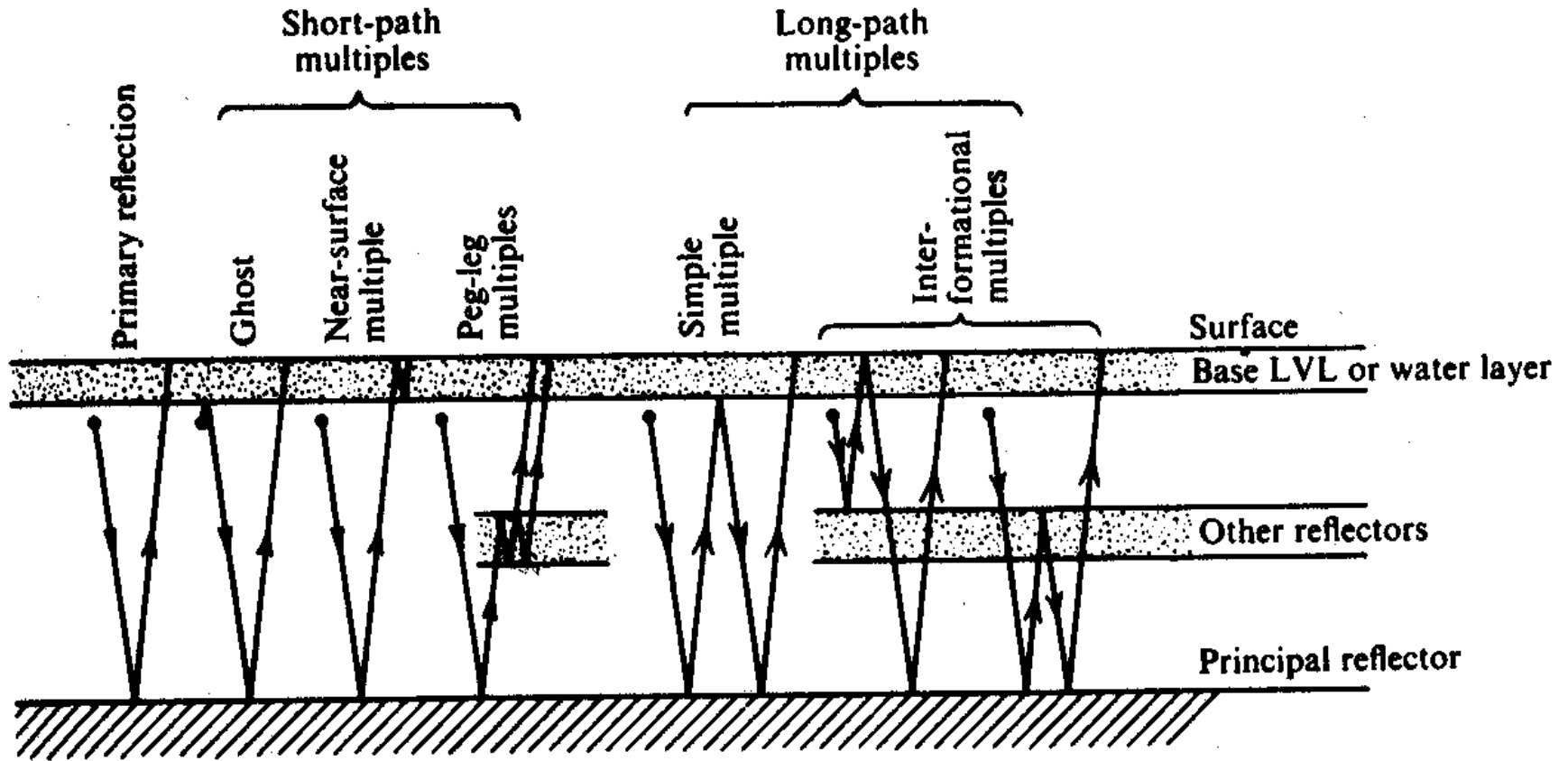
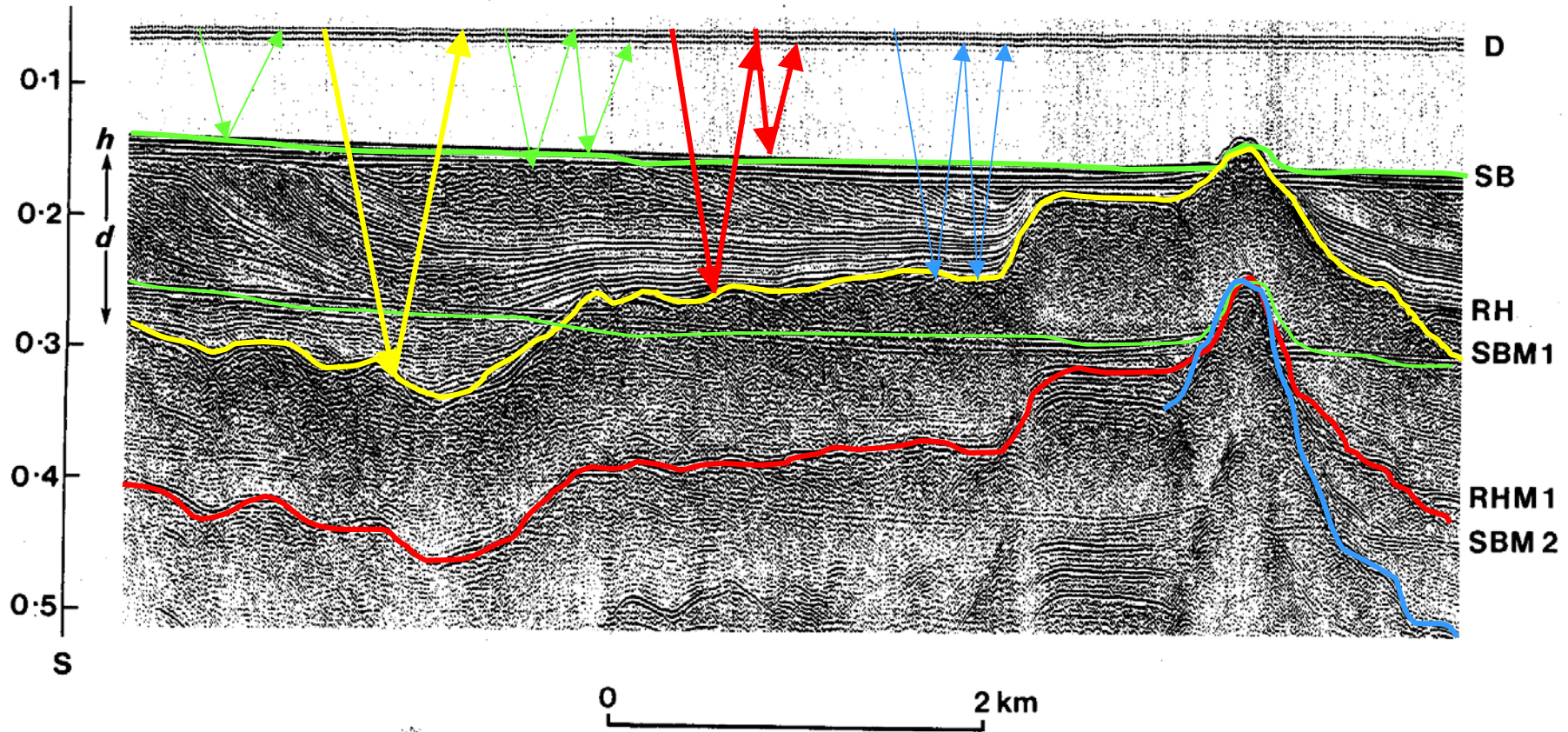
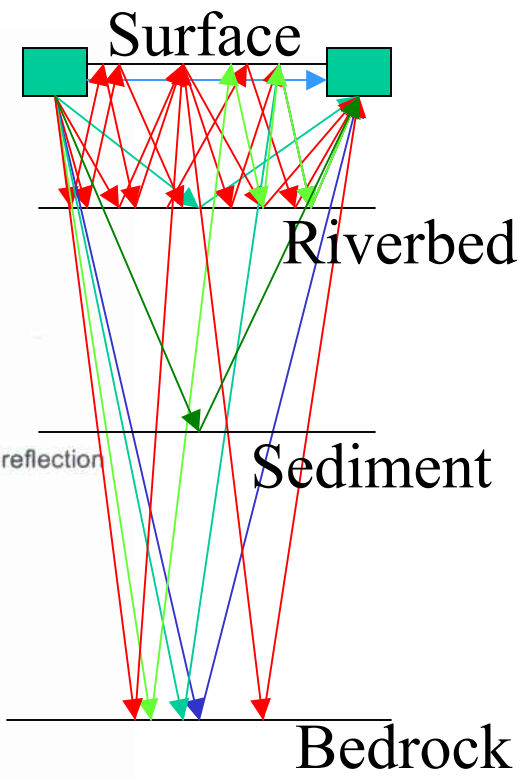
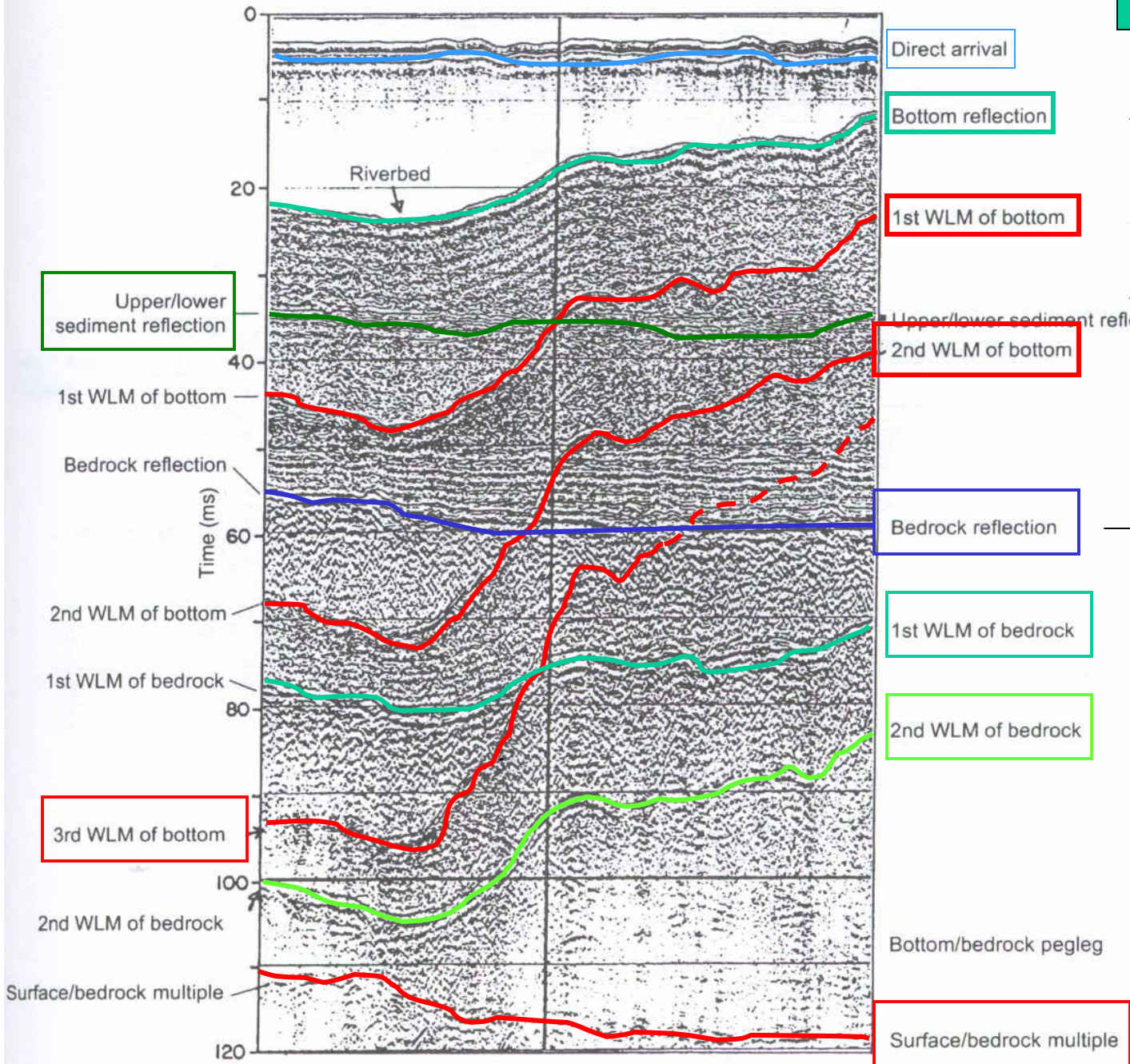


Fig. 6.29 Types of multiples.

Air gun record





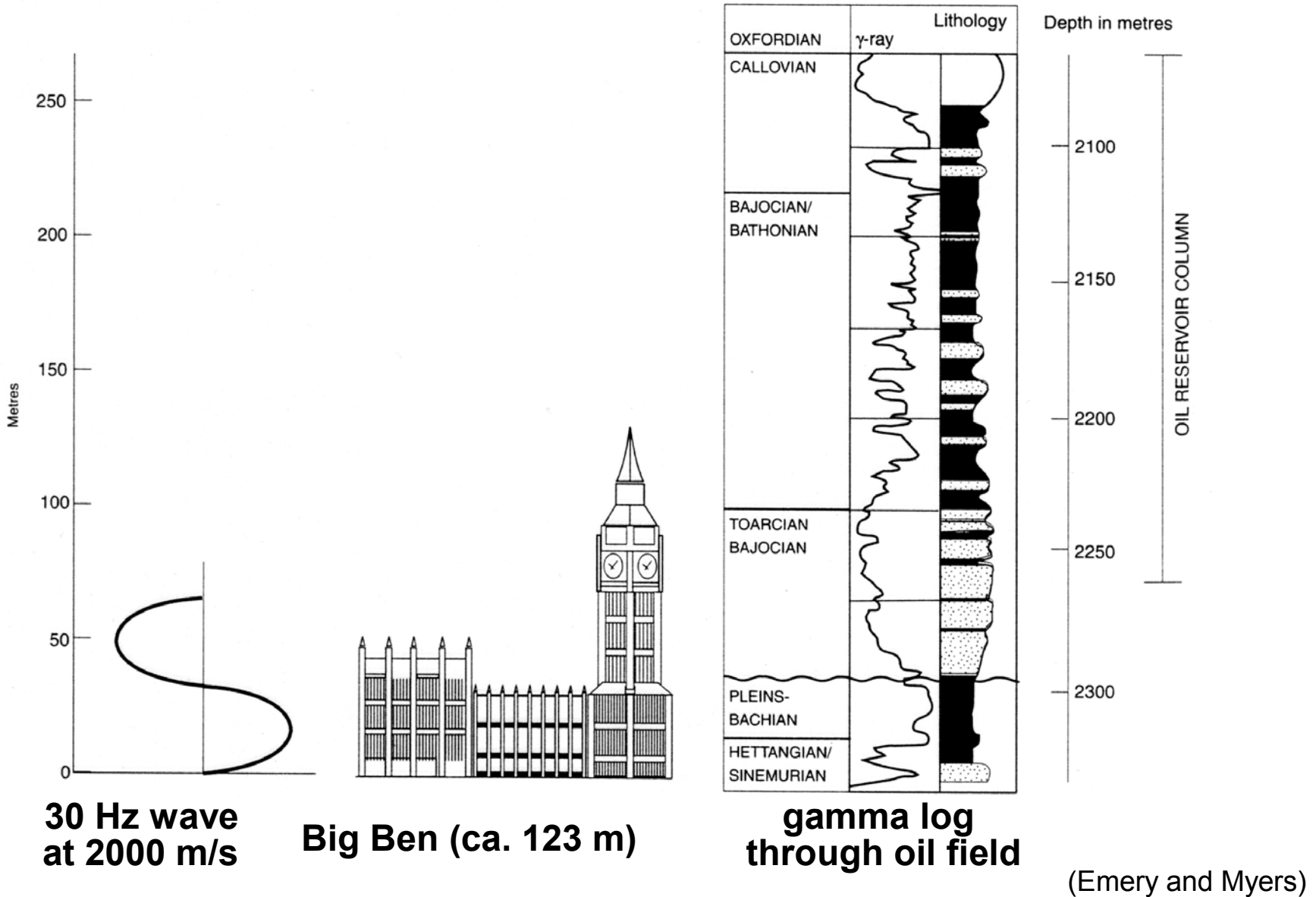
Reynolds

Resolution

Resolution refers to the minimum separation between two features such that we can tell that there are two features rather than only one.

- Vertical resolution
- Horizontal resolution

Comparison of resolution of different data sets



Vertical resolution

Rayleigh's-criterion:

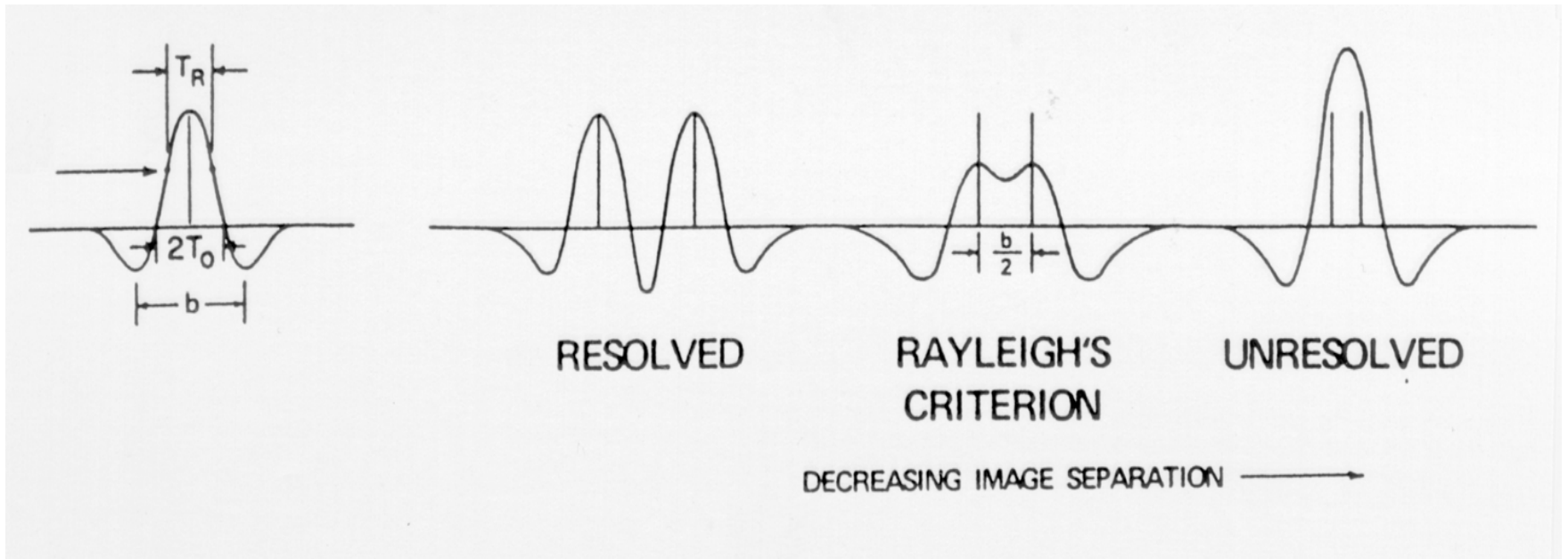
$$\frac{\lambda}{4}$$

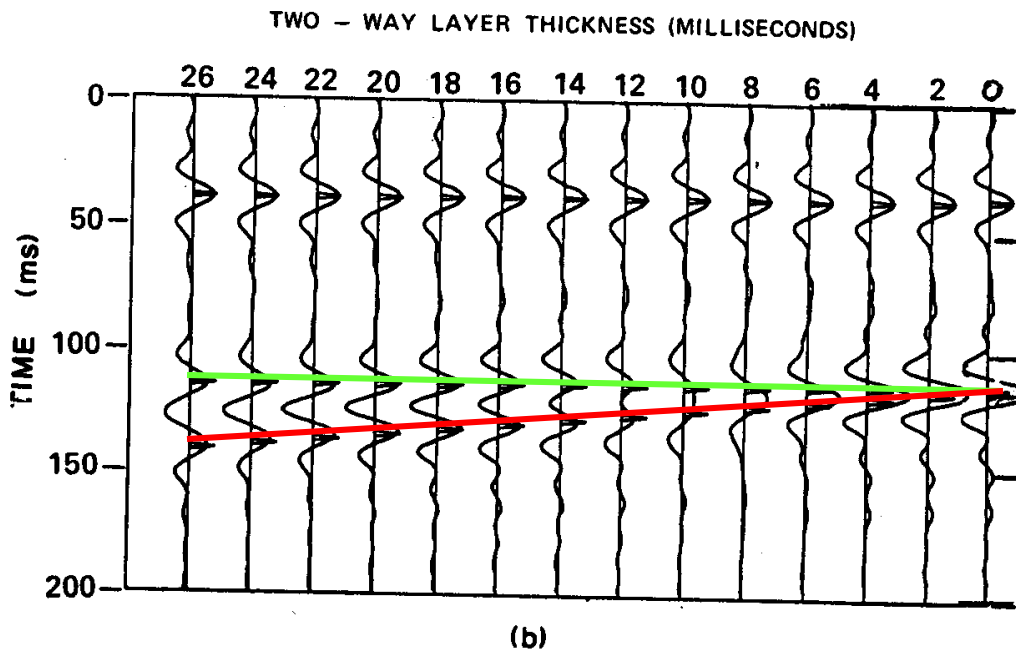
Vertical resolution depends on:

- **Frequency**
- **Velocity**

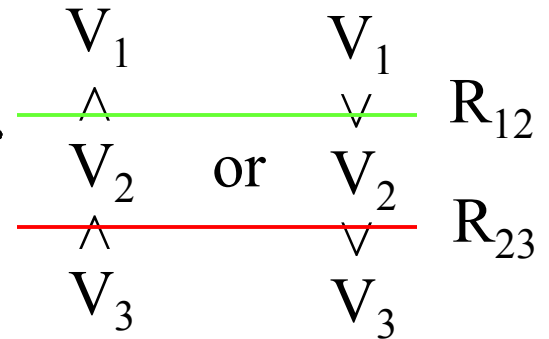
$$\lambda = \frac{v}{f}$$

Resolution of two boundaries depends on wavelength

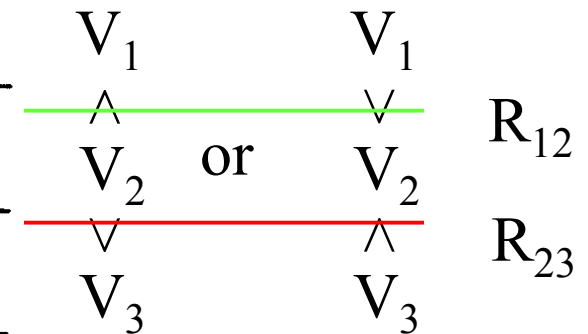
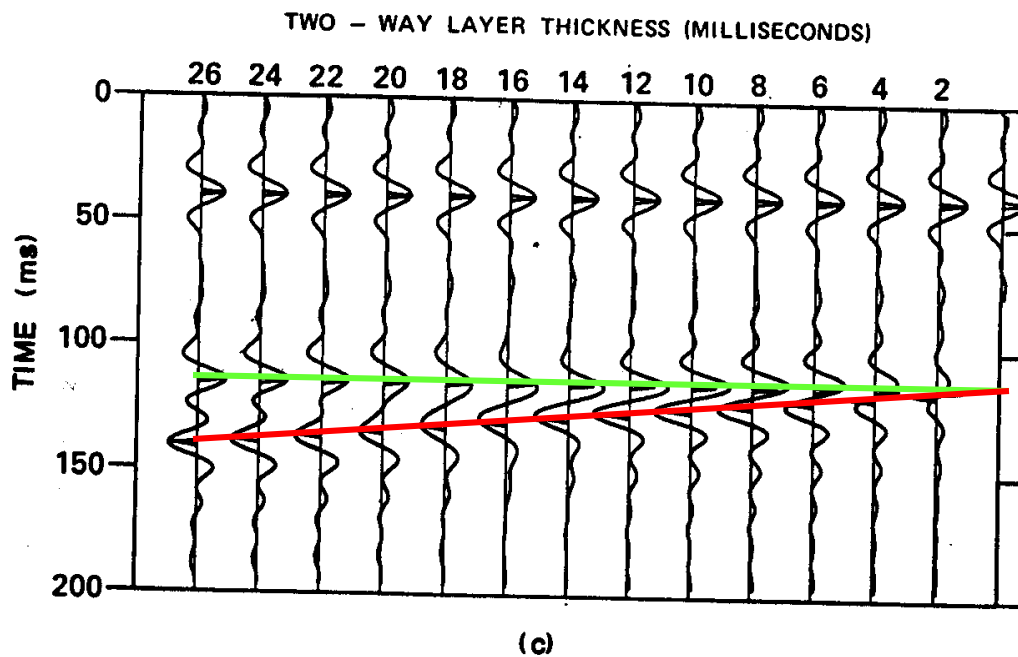




$$\lambda/4 = 12 \text{ ms}$$

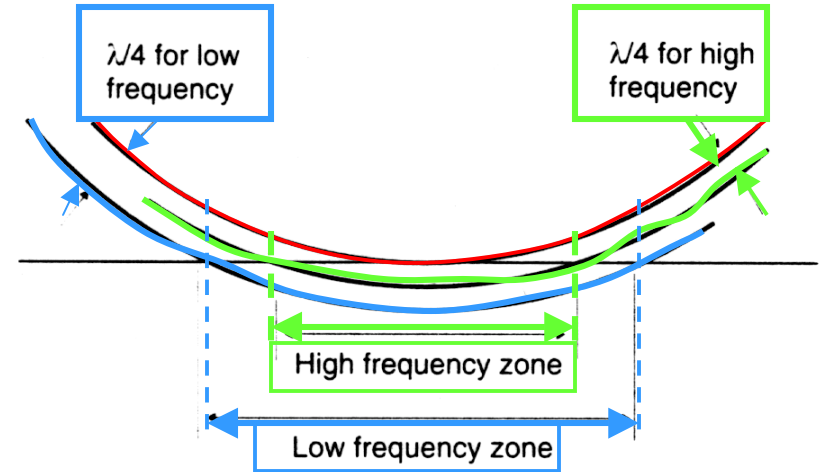
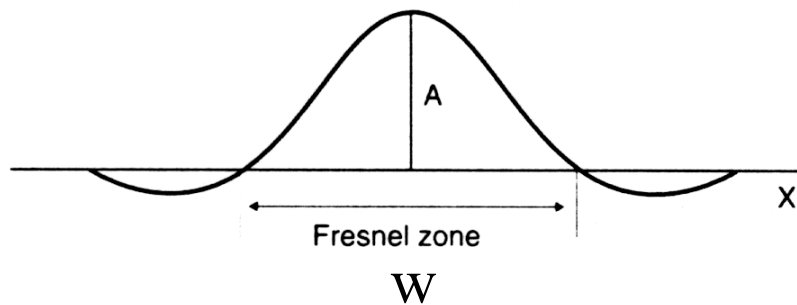
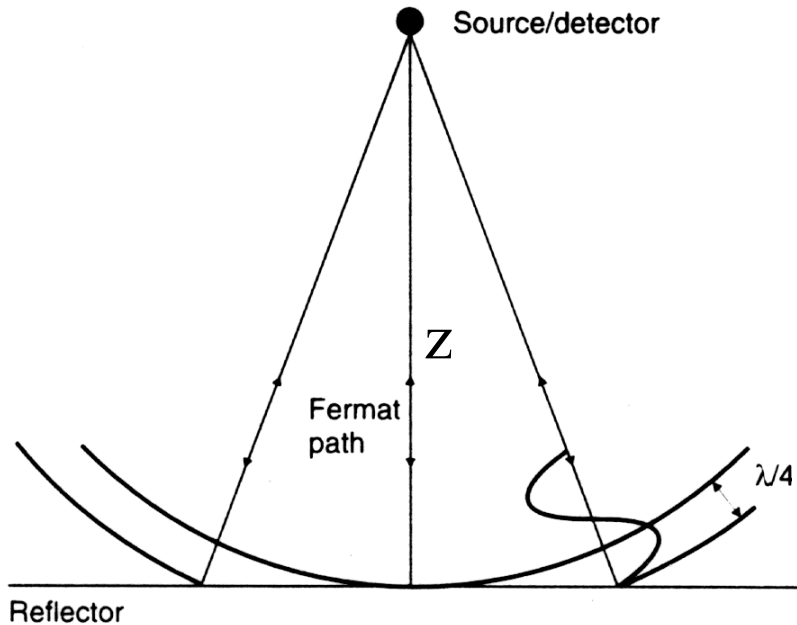


$$R_{12}/R_{23} = \text{pos.}$$



$$R_{12}/R_{23} = \text{neg.}$$

Horizontal resolution



$$W = \sqrt{2z\lambda}$$

for $z \gg \lambda$

Sampling theorem

At least two samples per apparent wavelength must be obtained in order to recognize features.

For example, to recognize a stream channel on a horizontal slice generally requires bin sizes no larger than $1/3$ or $1/4$ the channel width.