

# Reflection seismic 1 script

## **Educational Material**

**Author(s):**

Kruk, Jan van der

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# Amplitude Preservation

## **Important methods:**

- **Trace equalisation**
- **AGC - Automatic gain control**
- **Correction for spherical Divergence**
- **Programmable Gain functions**

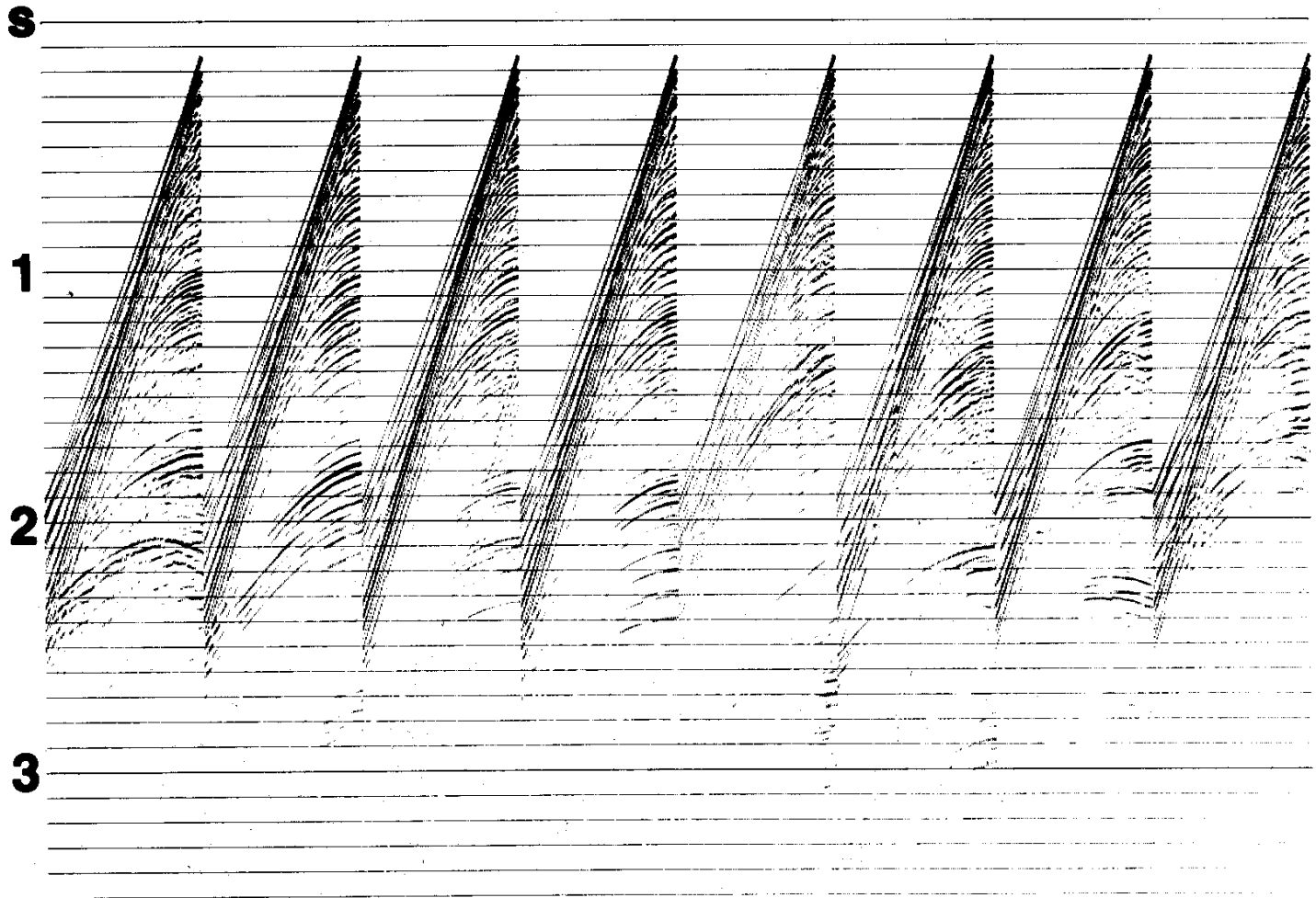
## **Loss of amplitude due to**

- Reflection and transmission at an interface
- Geometrical spreading
- Absorption
- Receiver response
- Measurement system

## **Problem for Data processing**

- **Individual large Amplitudes dominate the processing**
- **Reflections are difficult to recognize**
- **Strong amplitude contrasts influence the digital filtering (especially for large travel-times)**

# Common shot-gathers just after demultiplexing



## Correction for spherical divergence

Homogeneous space:  $A(t) = \frac{1}{r} \Rightarrow G(t) = v \cdot t$

Layered space:  $A(t) = \frac{1}{[v_{rms}(t_{tw})]^2 t_{tw}} \Rightarrow G(t) = [v_{rms}(t_{tw}) / v(0)]^2 [t_{tw} / t_{tw}(0)]$

### Advantage:

Physical base for amplitude correction

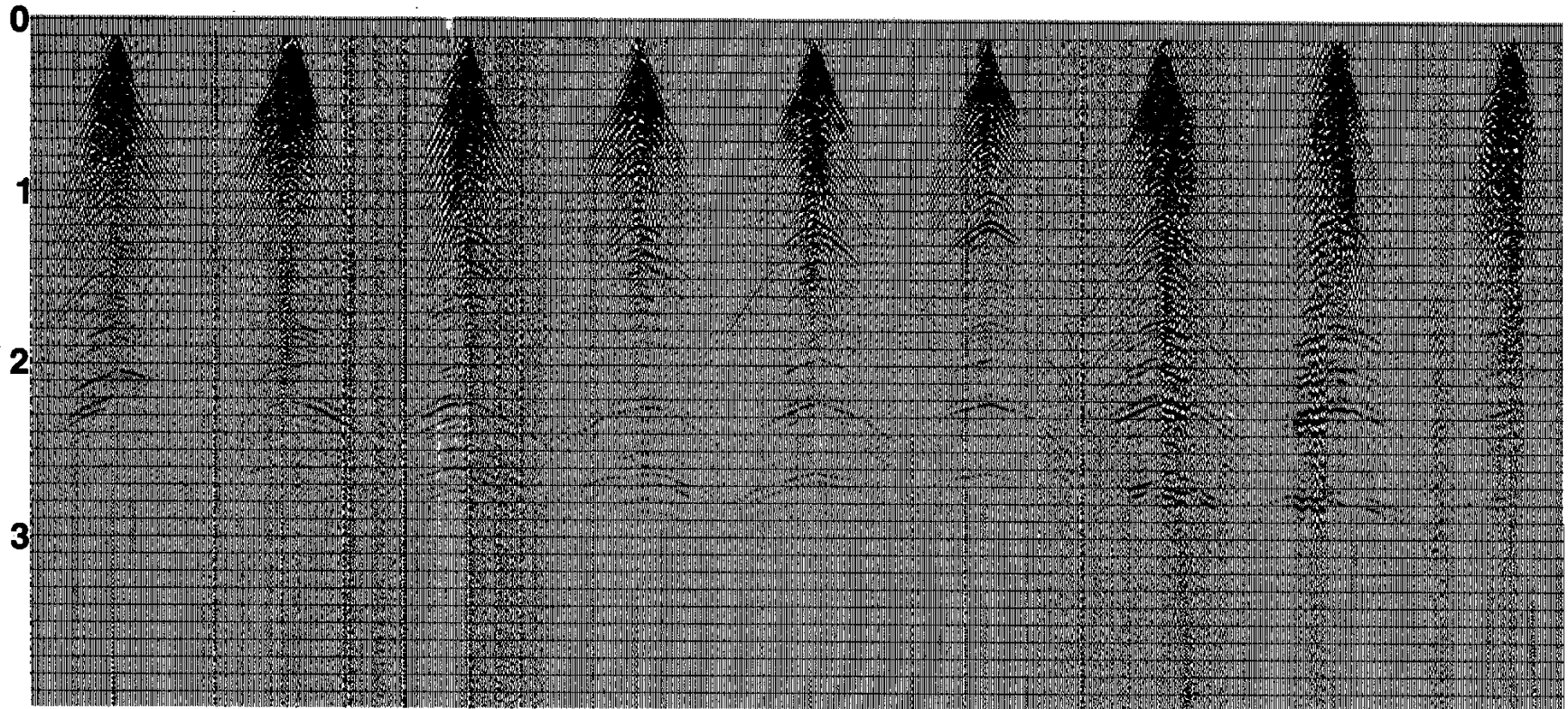
Relative Amplitude difference remains equal

### Disadvantage:

Velocity function not known beforehand

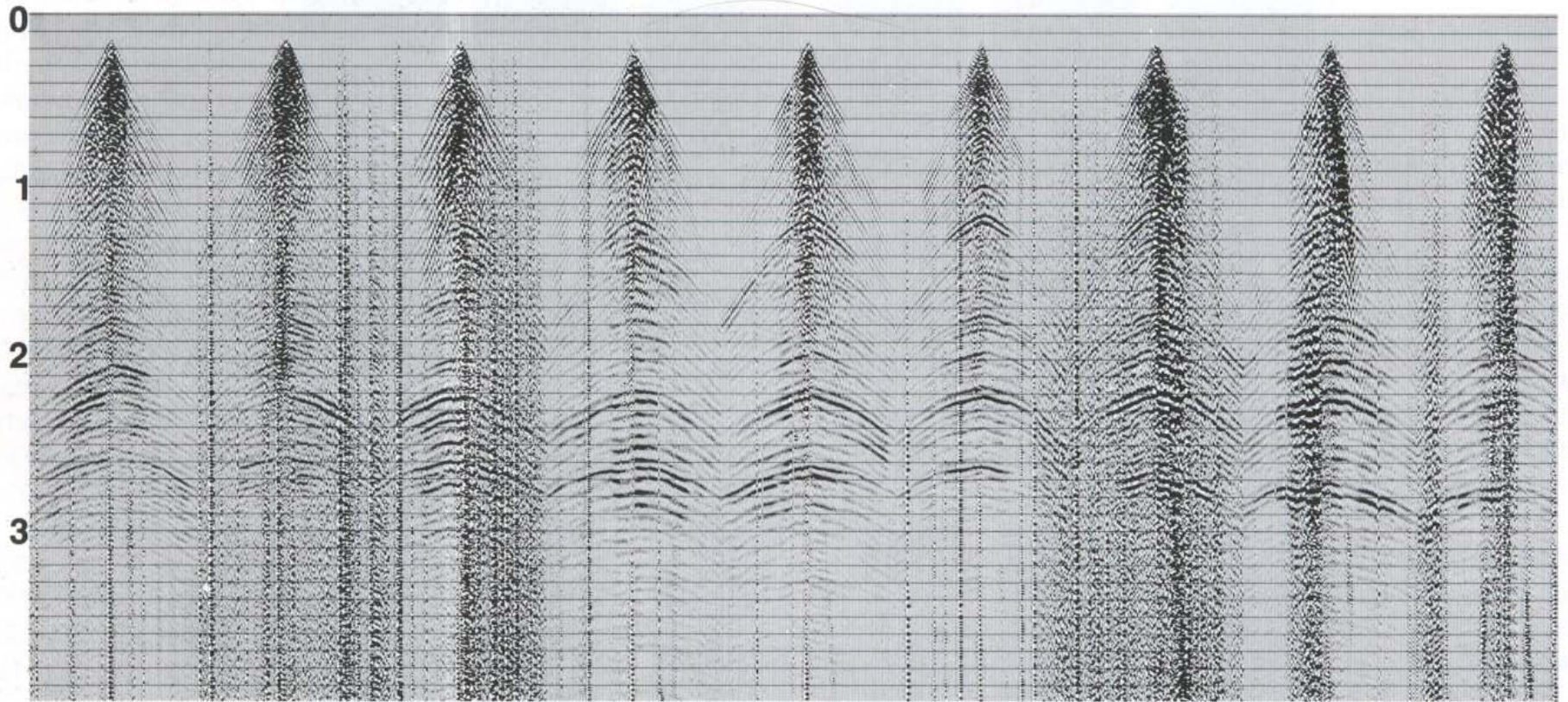
Noise sources can still remain dominant

# Raw field records from land survey



Rapid decay in amplitudes at late times

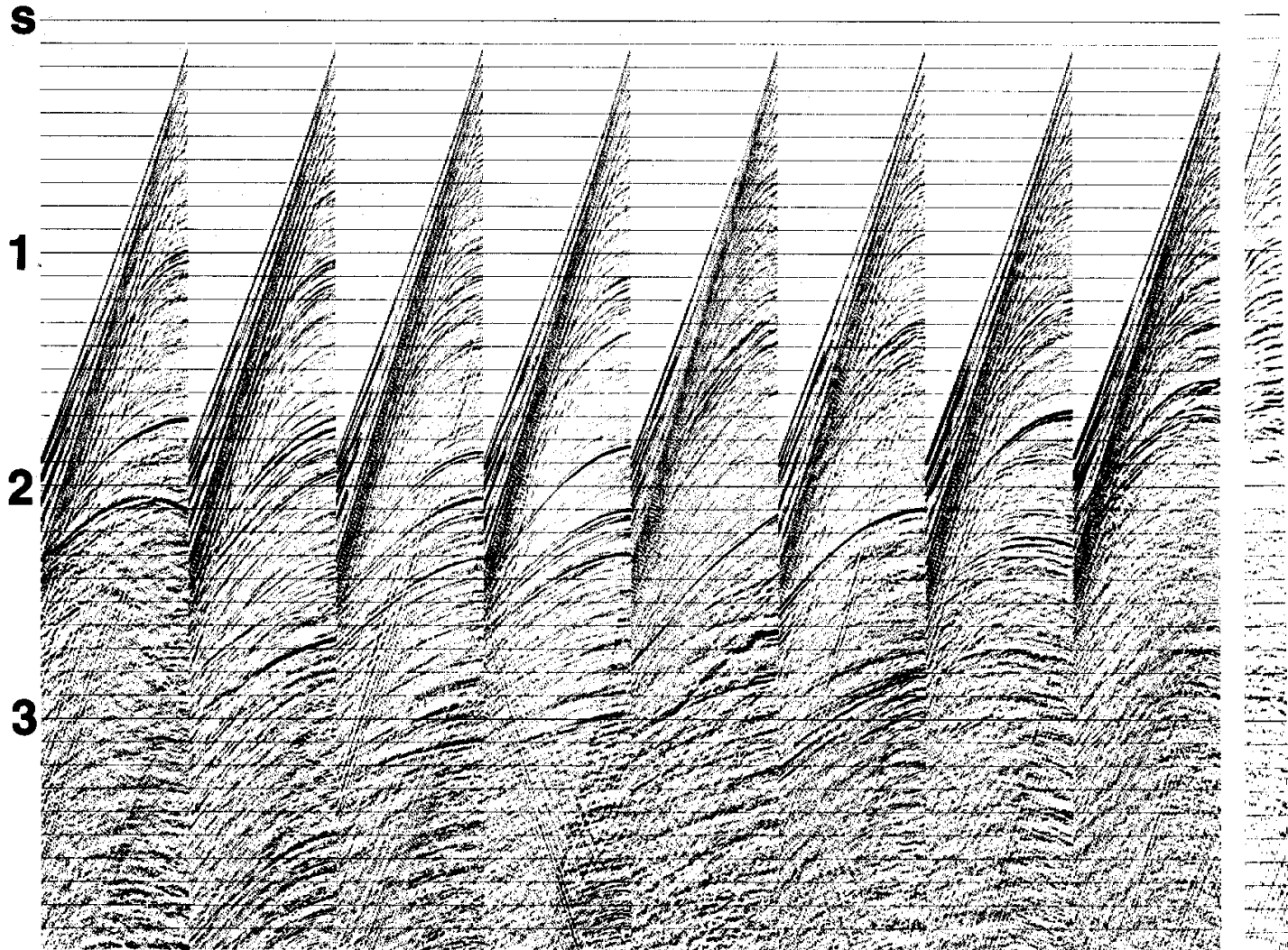
# Corrected field records from a land survey



Restored amplitudes at late times  
(unfortunately ambient noise also has been strengthened)



# Common shot gathers just after deconvolution After trace balancing Corrected for wavefront divergence



# AGC - Automatic Gain Control

**Normalization of amplitude for a certain time sample in a certain time window (not for the whole trace)**

## **Advantage:**

**All traces are more equal which is needed for further processing  
(Stacking: summation of different traces)**

**Amplification of Amplitudes for larger travel times**

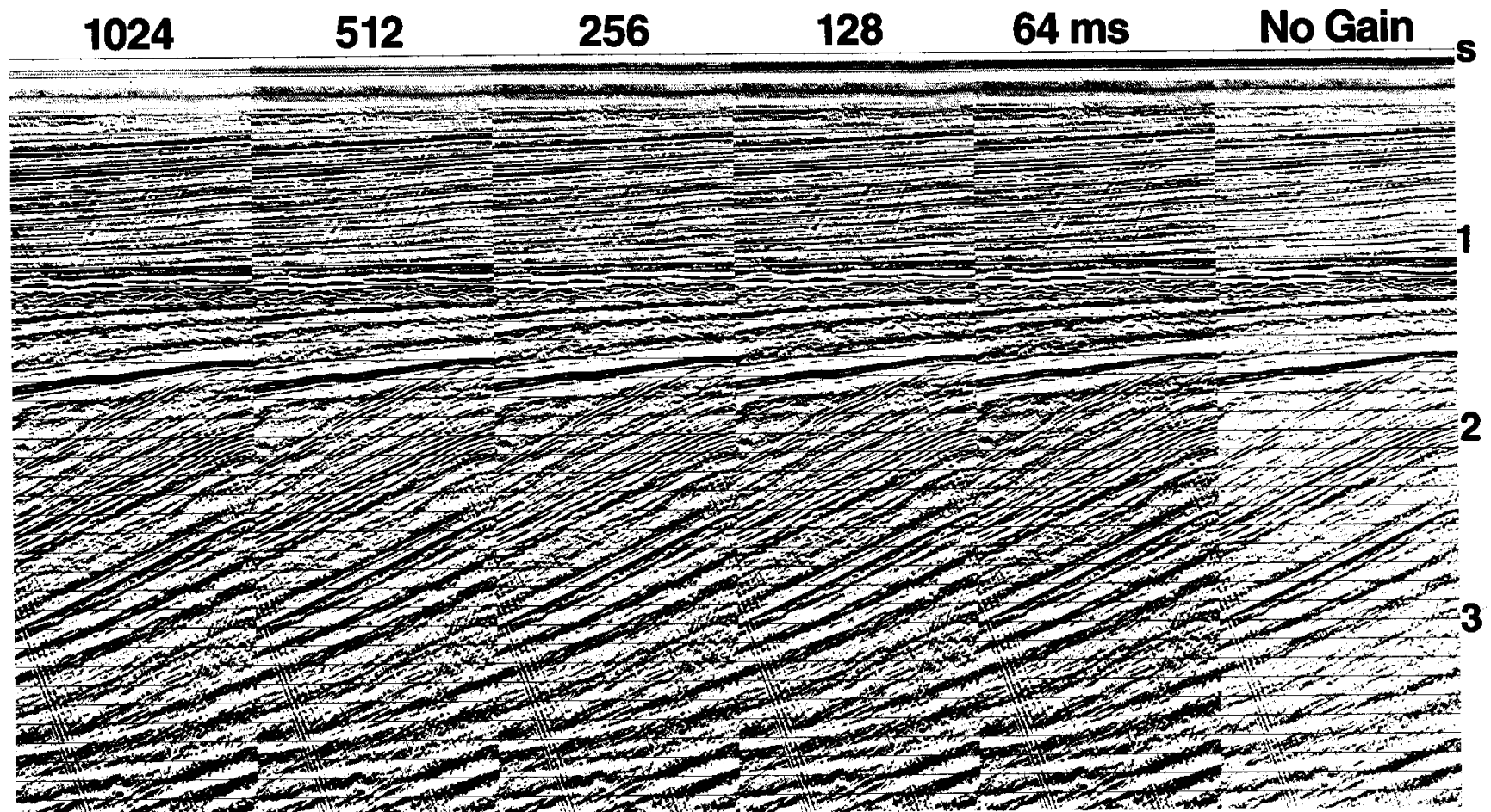
## **Disadvantage:**

**No physical base for amplification**

**Shadow effect**

**Can lead to amplification of noise**

# Different AGC functions



Numbers on top indicate gain window sizes in milliseconds

# Programmable Gain function

Compensation for losses and geometrical spreading:

$$A(t) = A_0 k t^n e^{at}$$

## Advantage:

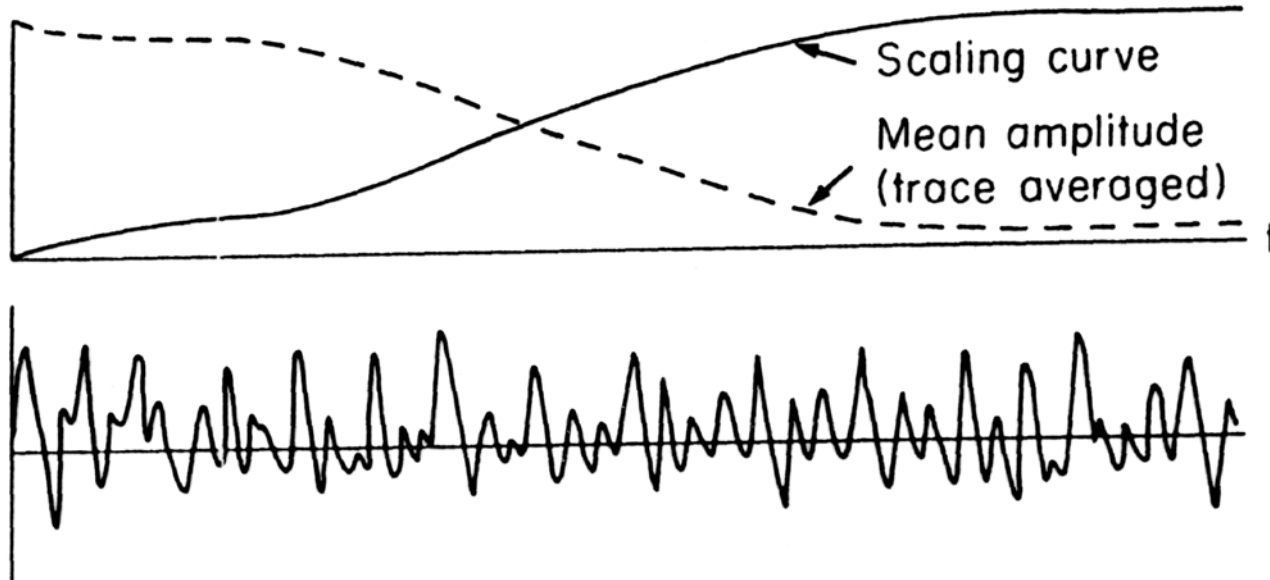
Partly based on physics

Known function: original data can be recovered

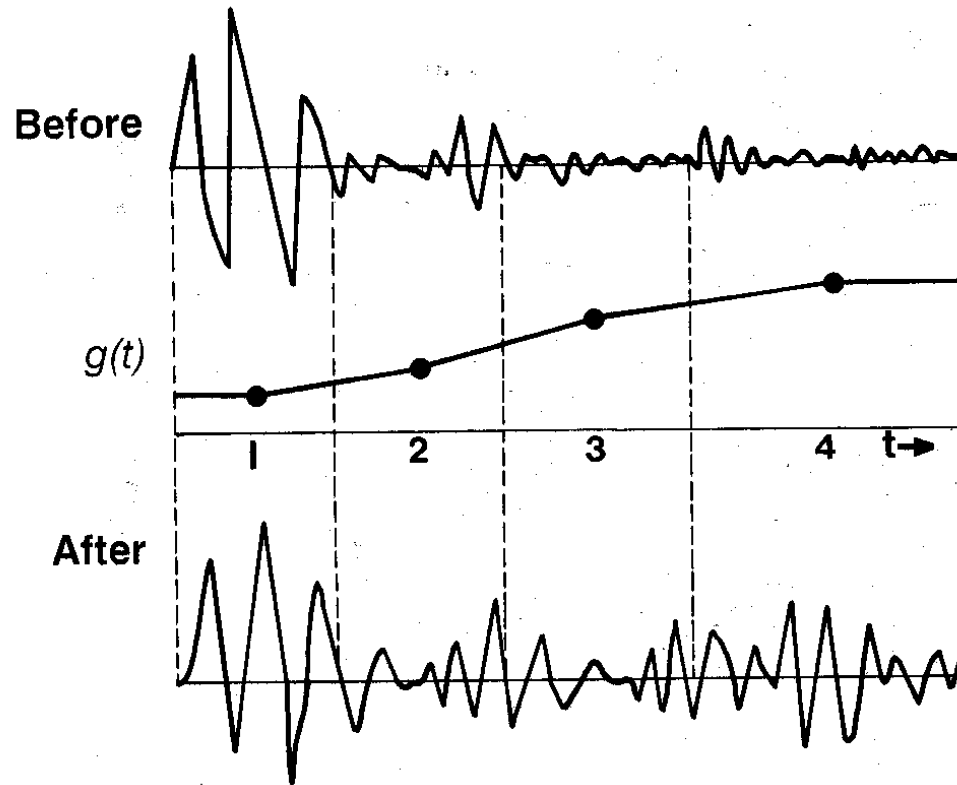
## Disadvantage:

Results depend strongly on used gain function

# programmed gain curve

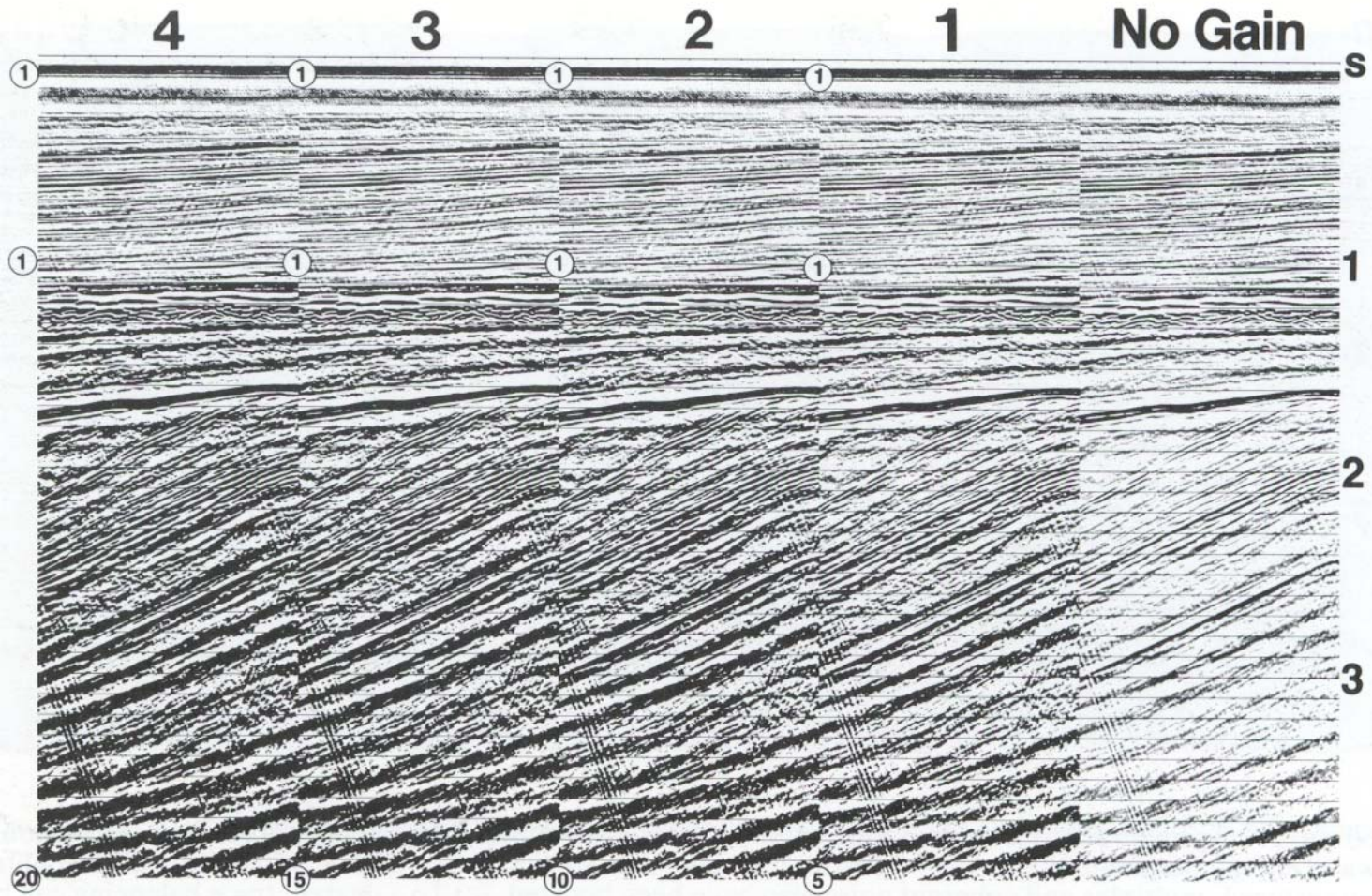


**Calculation of decay of amplitude and determine a Gain function**





# Four different PGC functions



Scale factors are indicated by the circled numbers at the times of application

# Trace balancing

All traces are normalized using a certain amplitude:

**RMS**

**Median value**

**Maximum Value**

## **Advantage:**

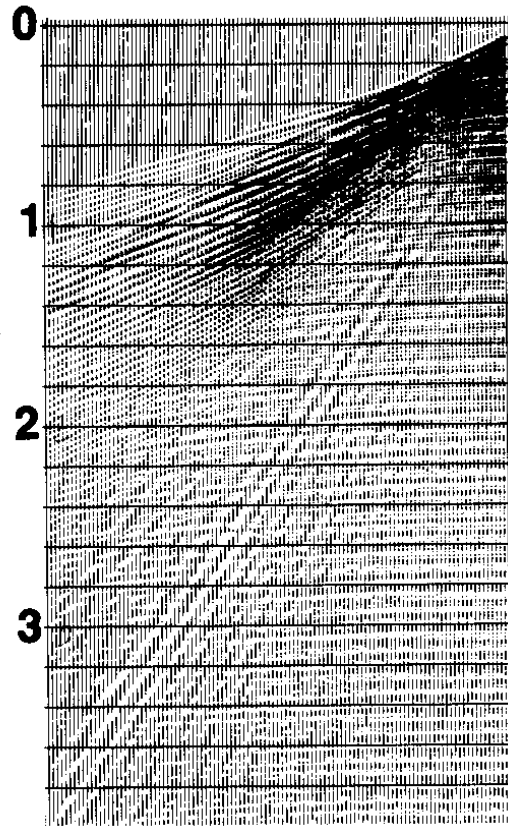
All traces are more equal which is needed for further processing  
(Stacking: summation of different traces)

## **Disadvantage:**

No physical base for amplification  
No equalisation of losses with time  
Large value in a trace can dominate

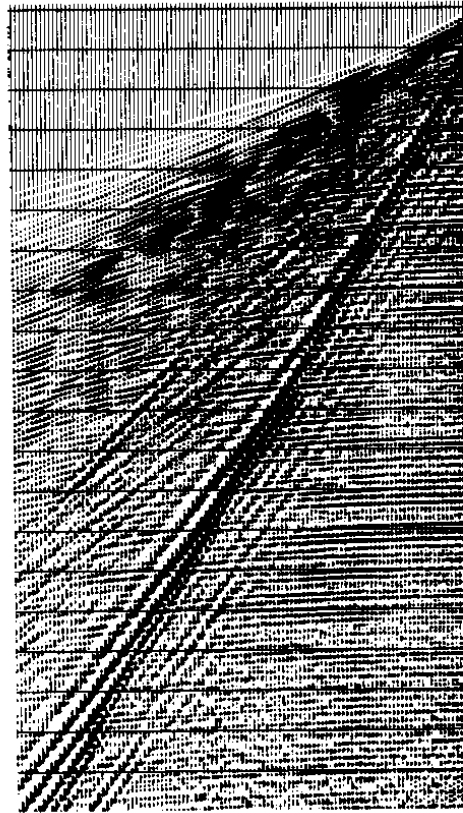


# Field record from marine survey



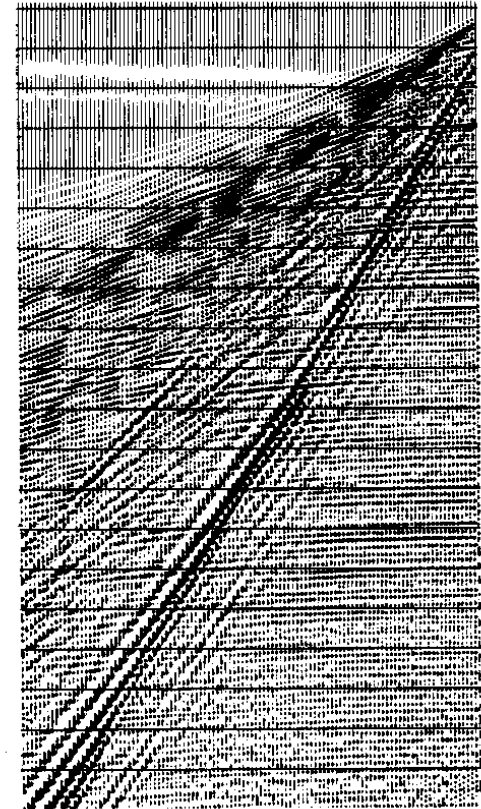
(a)

Raw field record



(b)

+Geometric spreading  
correction



(c)

+Trace balancing