

Filters and Their Description

(after F. Scherbaums book “Of Poles and Zeroes”)

Motivation

From source to receiver...

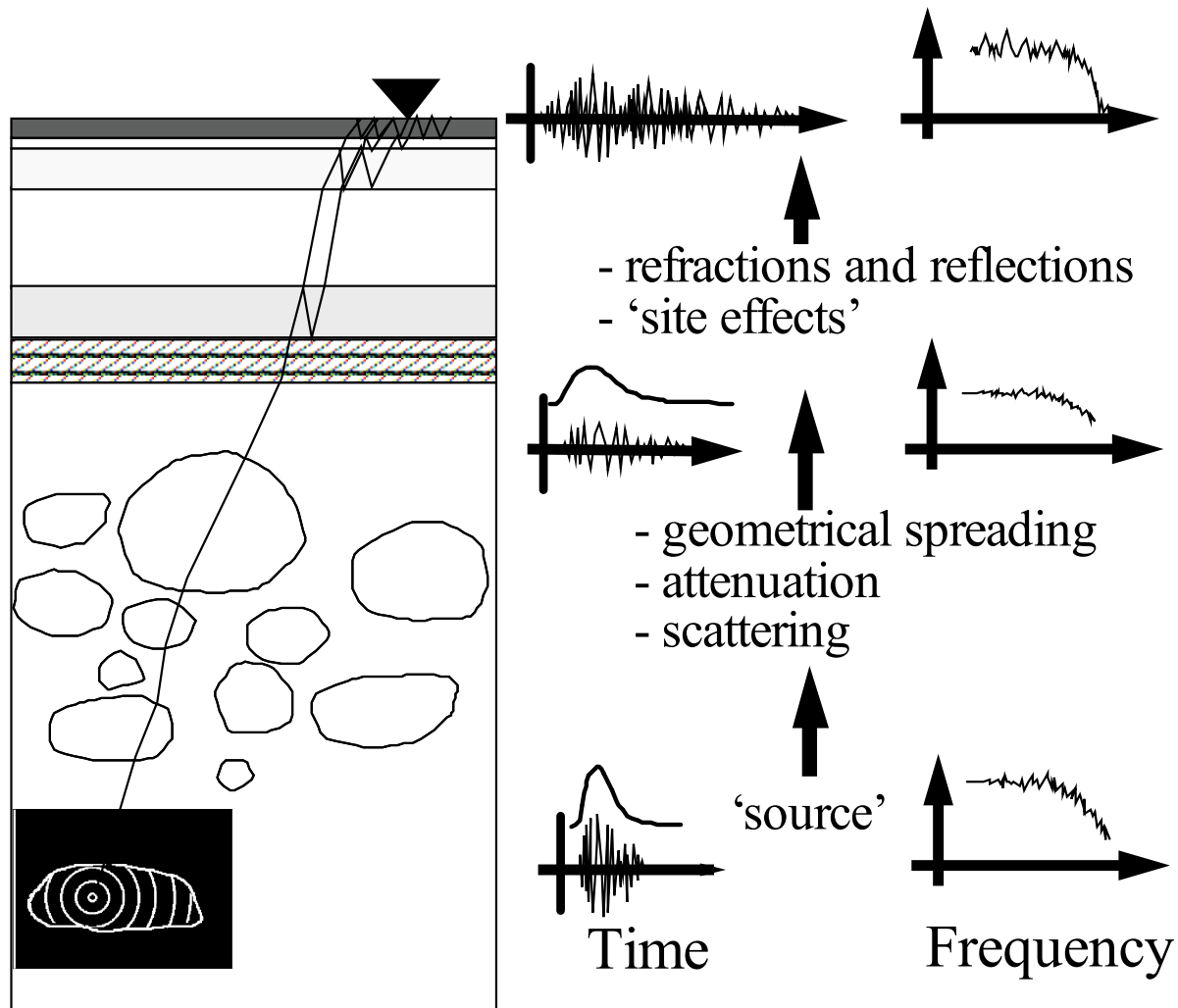


Fig. 1.1 Signal distortion during wave propagation from the earthquake source to the surface.

Influence of recording system

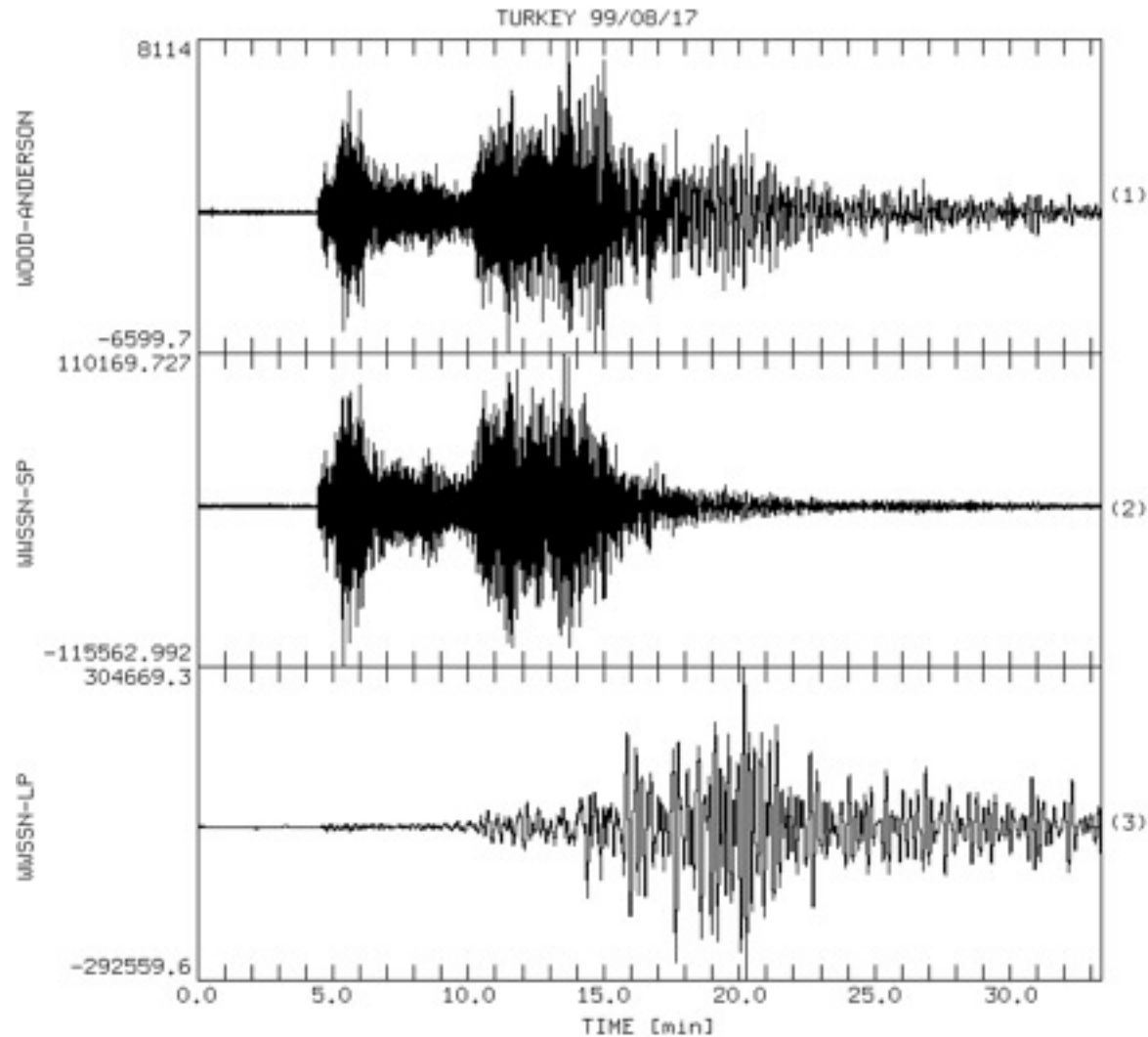


Fig. 1.2 Vertical component record of the Izmit earthquake in Turkey (1999/08/17) recorded at station MA13 of the University of Potsdam during a field experiment in Northern Norway. Shown from top to bottom are the vertical component records for a: Wood-Anderson, a WWSSN SP, and a WWSSN LP instrument simulation.

Sampling process

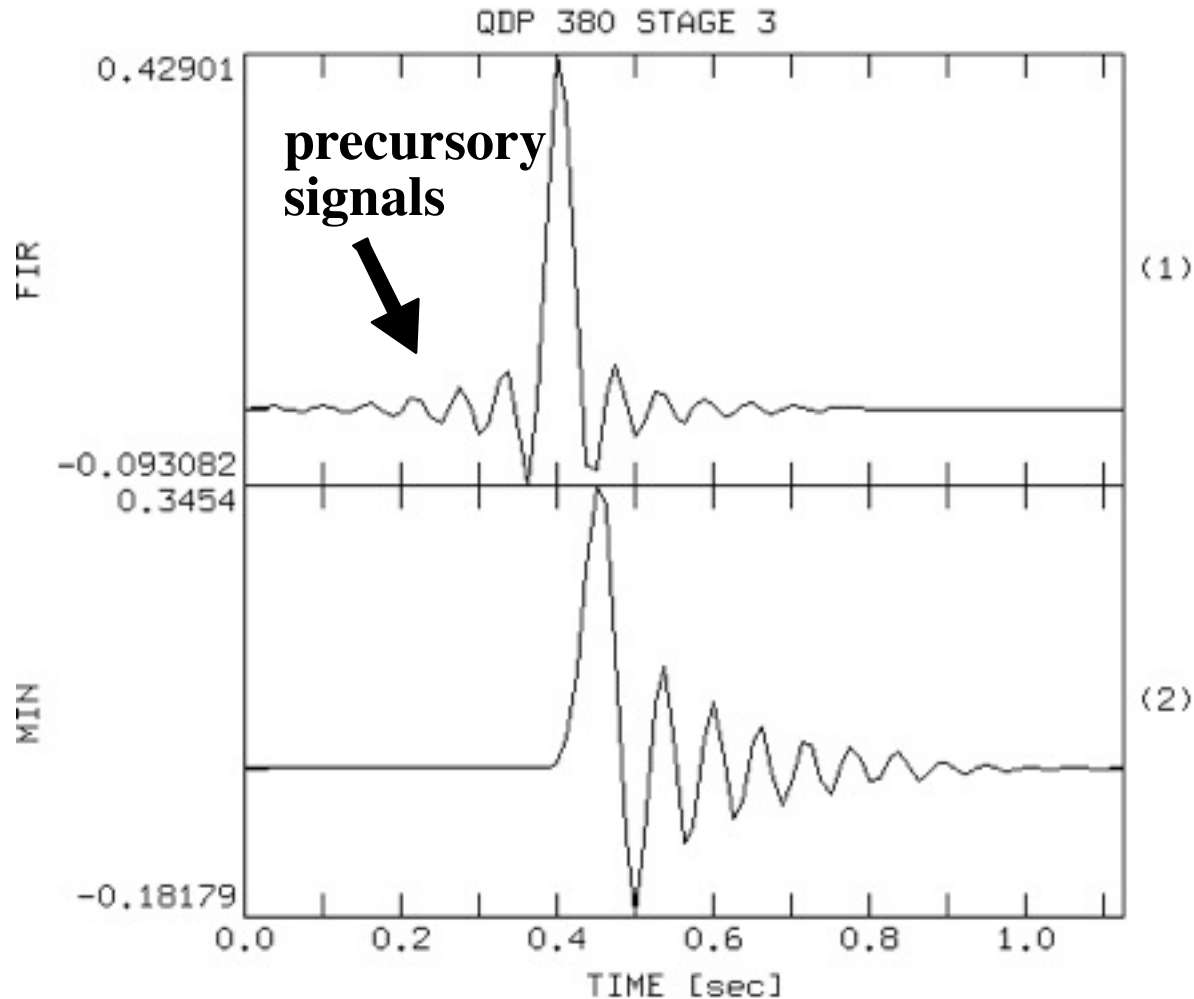


Fig. 1.3 Impulse response of stage 3 of the two-sided decimation filter incorporated in the Quanterra QDP 380 system (top trace). The bottom trace shows a filter response with an identical amplitude but different phase response.

How to obtain source parameters

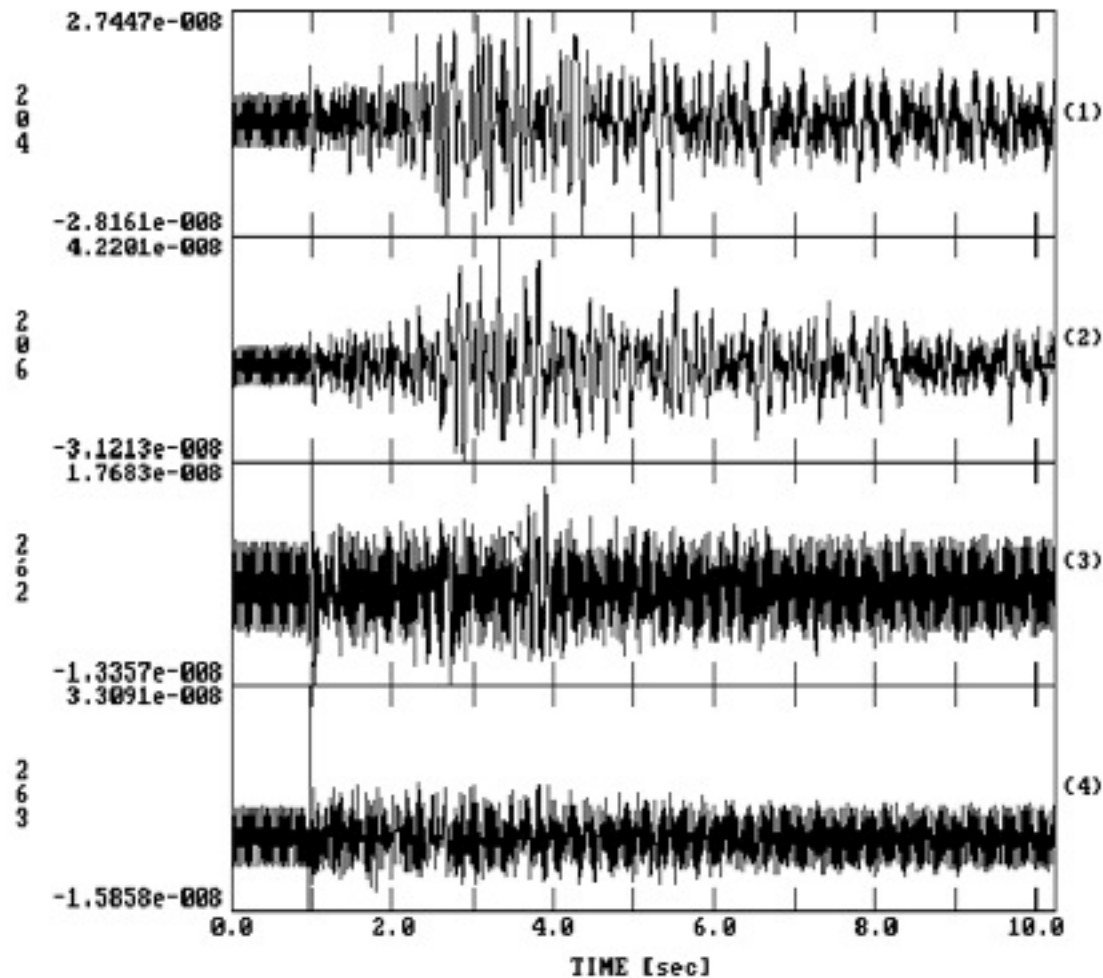


Fig. 1.4 Vertical component, velocity records of stations 204, 206, 262, and 263, respectively of event 4 of the Chalfant Valley aftershock sequence (cf. Luzitano, 1988). Notice the monochromatic noise that has been artificially superimposed on the data to simulate the effects of crosstalk.

Noise removal

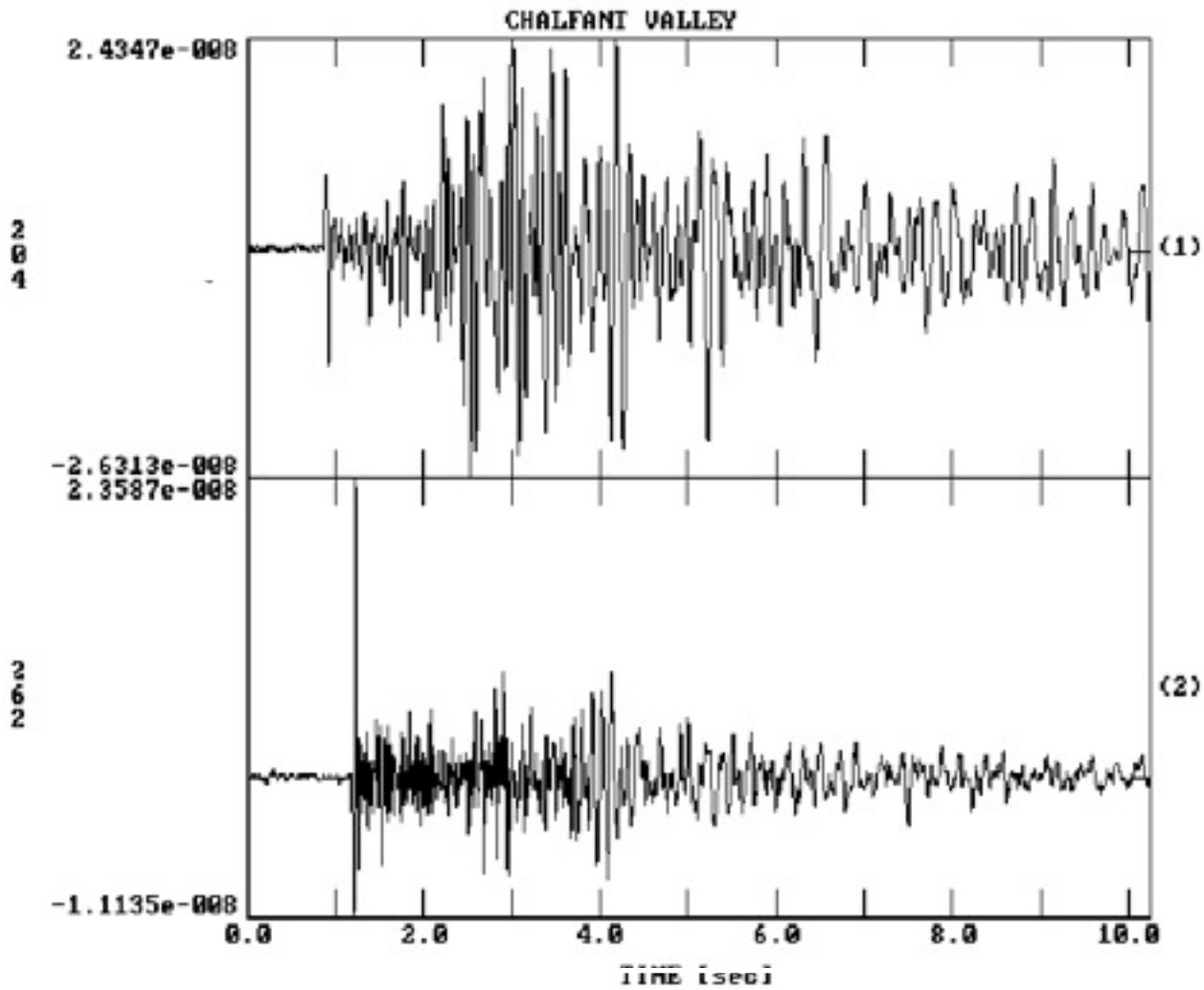


Fig. 1.5 Velocity records of stations 204, and 262, respectively, of event 4 of the Chalfant Valley aftershock sequence after noise removal.

Frequency response

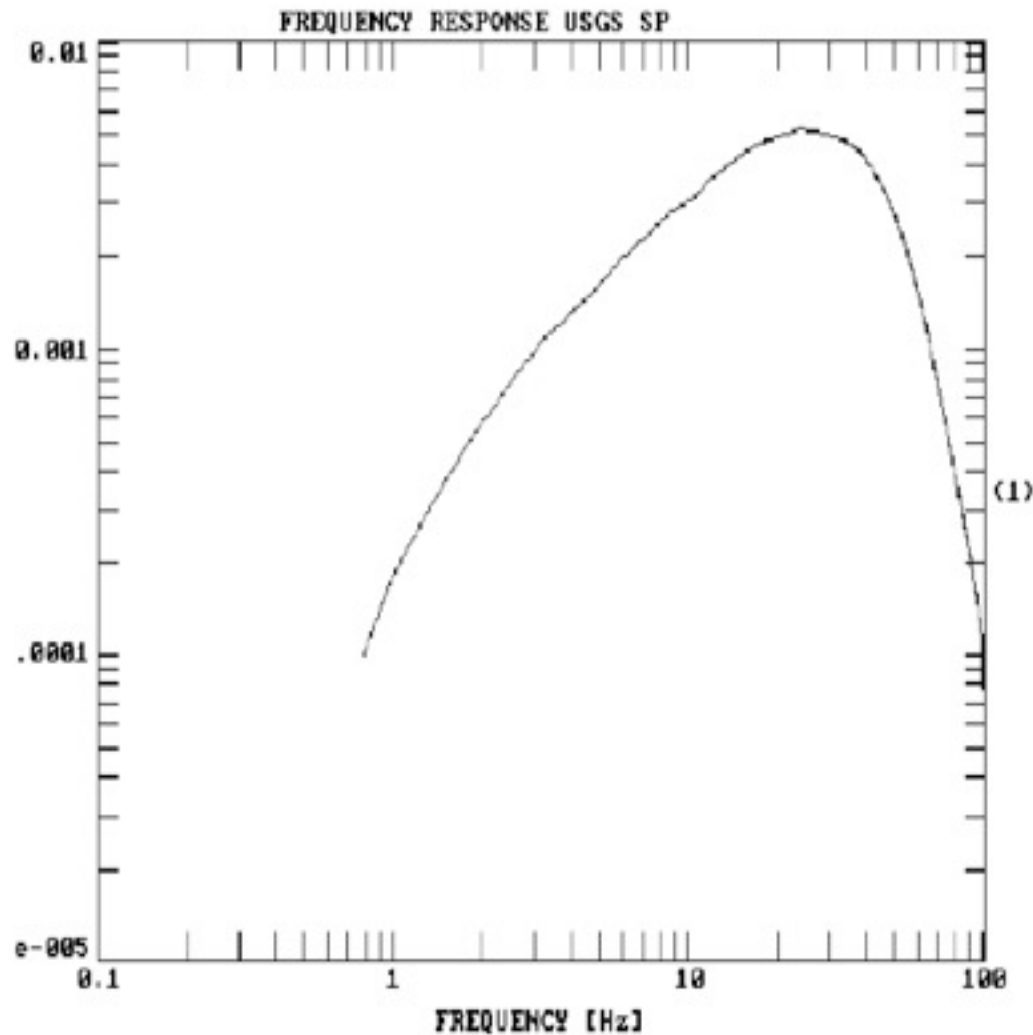


Fig. 1.6 The theoretical frequency response function (modulus) for the USGS short- period refraction system (normalized response to ground displacement). After Luzitano (1988).

Displacement record

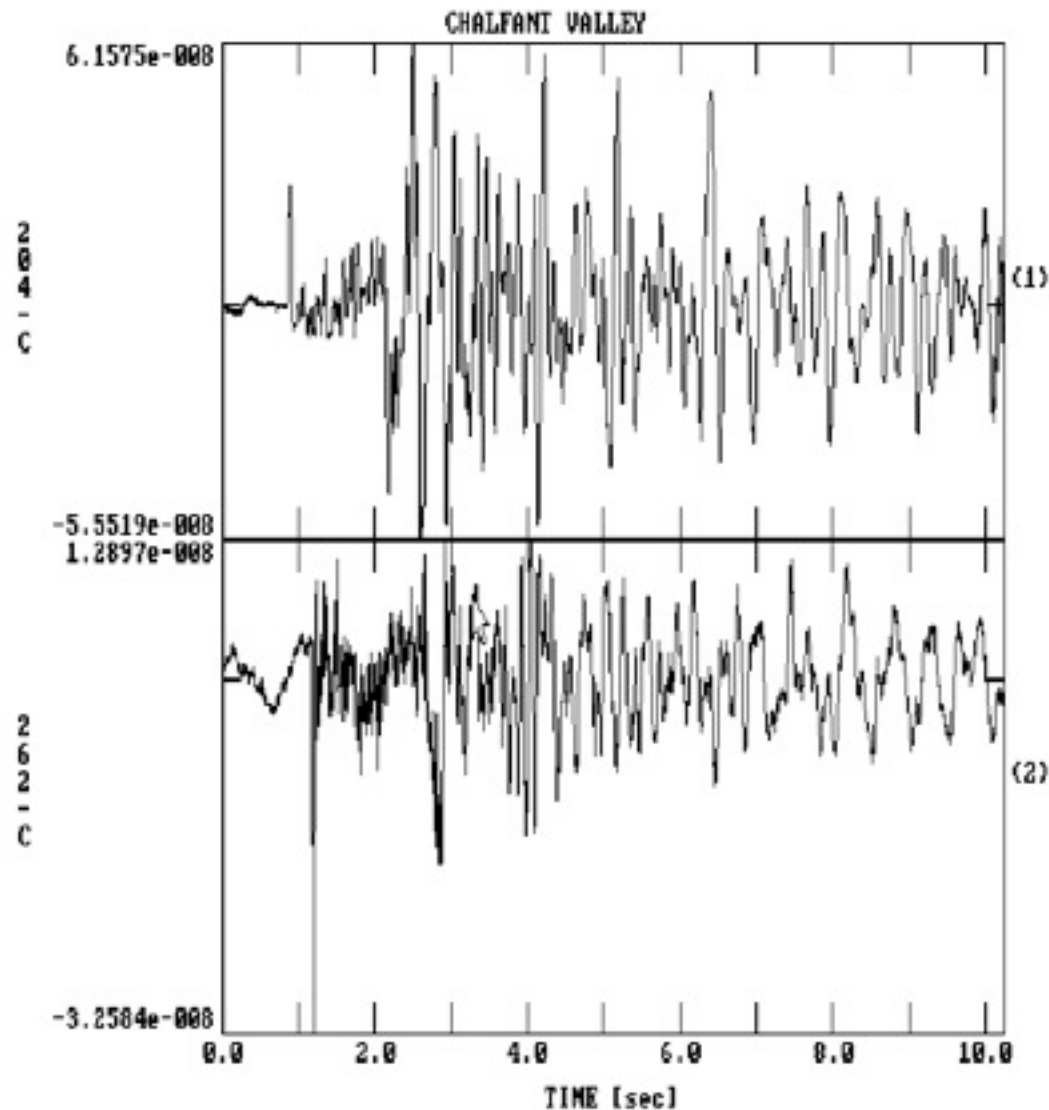


Fig. 1.7 Instrument corrected displacement records of the signals shown in Fig. 1.5.

Displacement spectrum

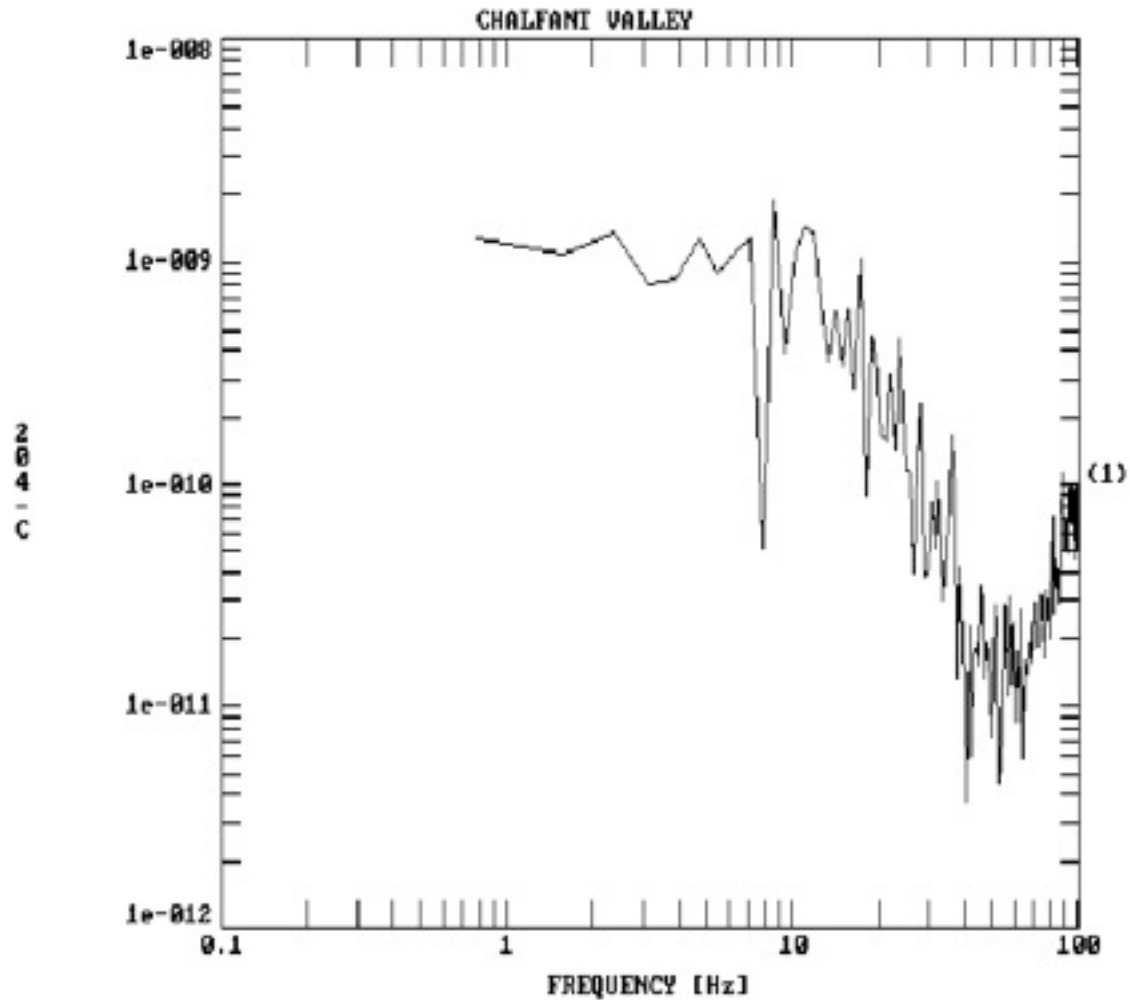


Fig. 1.8 Displacement spectrum for the P- wave portion of the instrument corrected displacement record of station 204 (top trace in Fig. 1.7).

Displacement spectrum

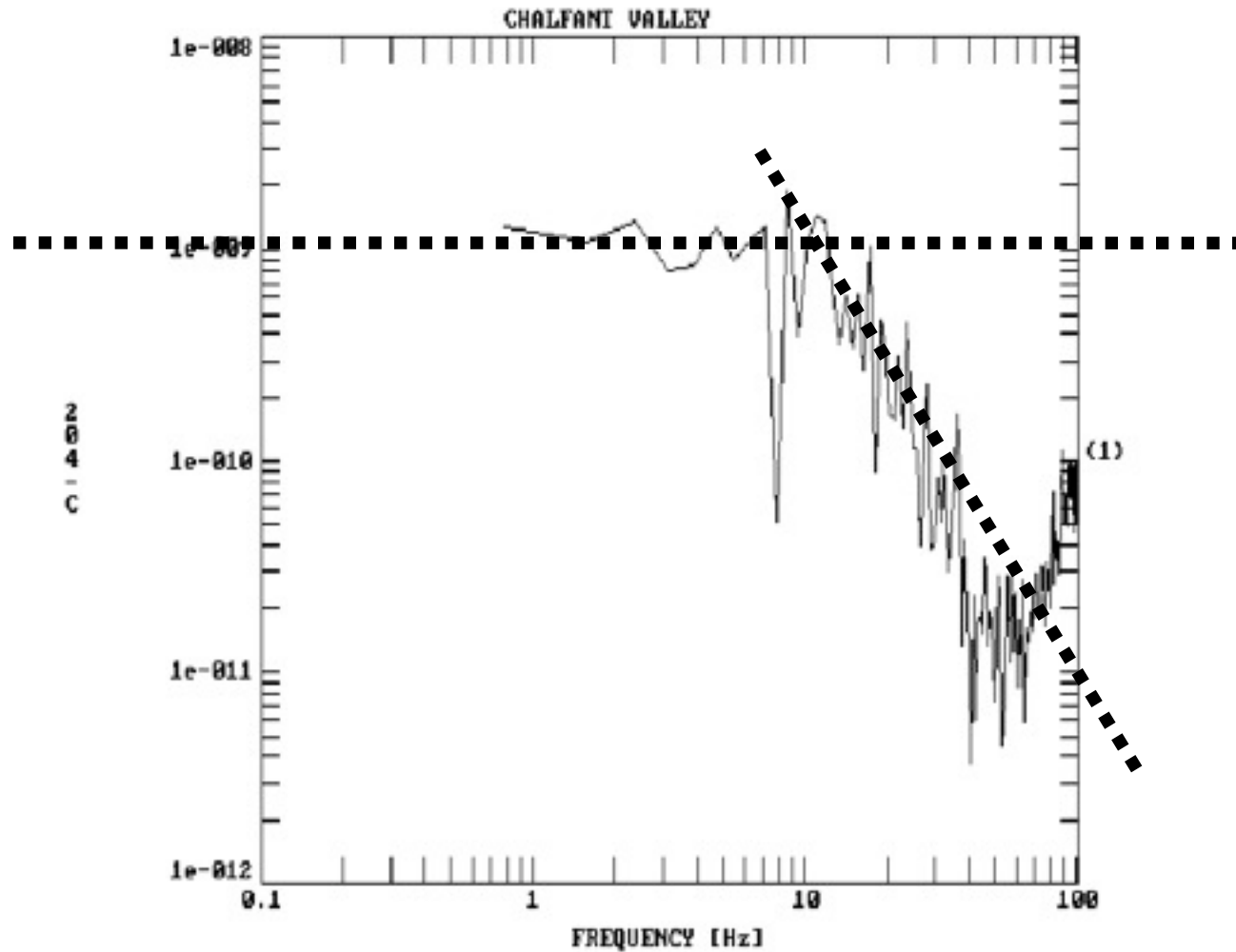


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Displacement spectrum

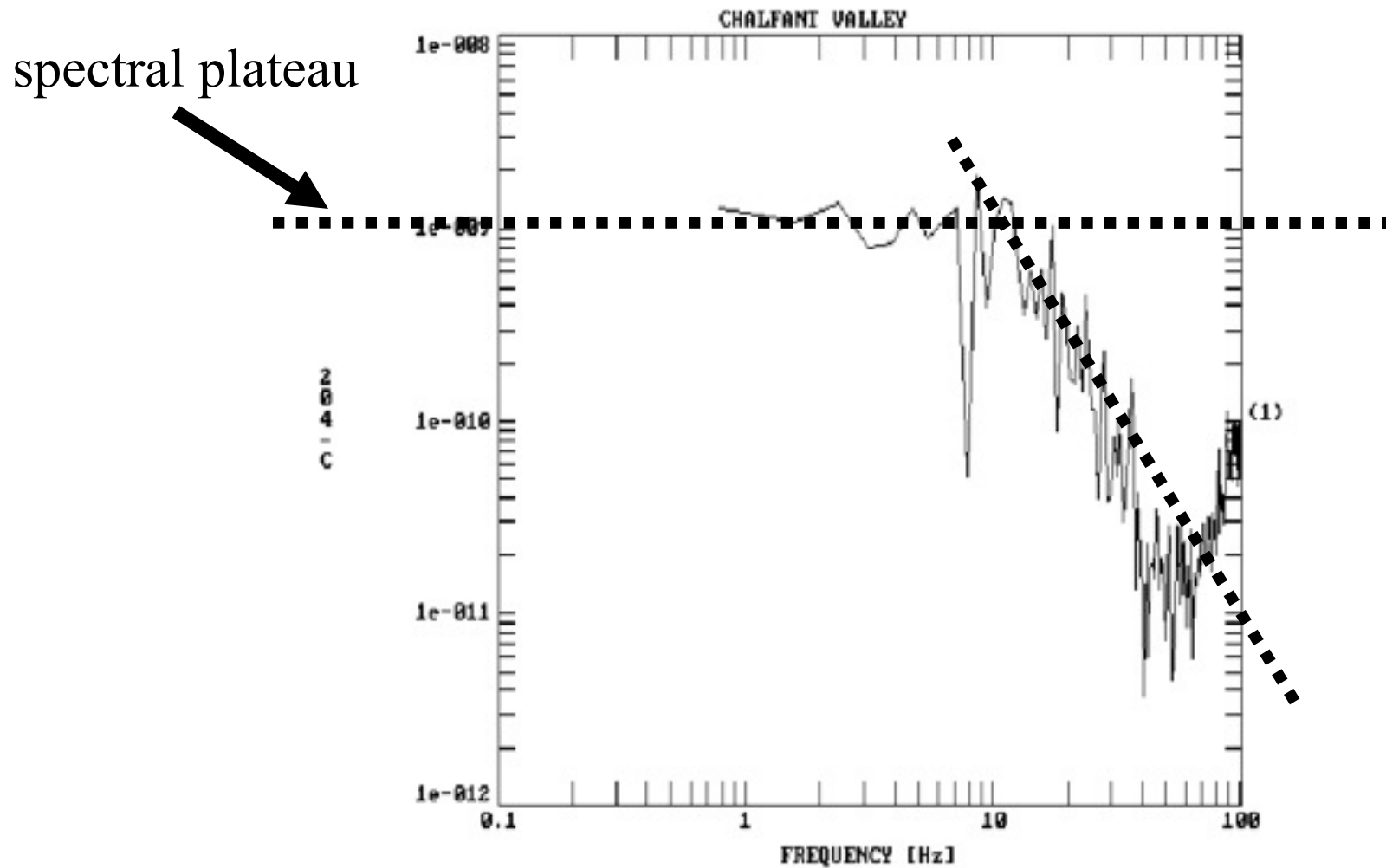


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Displacement spectrum

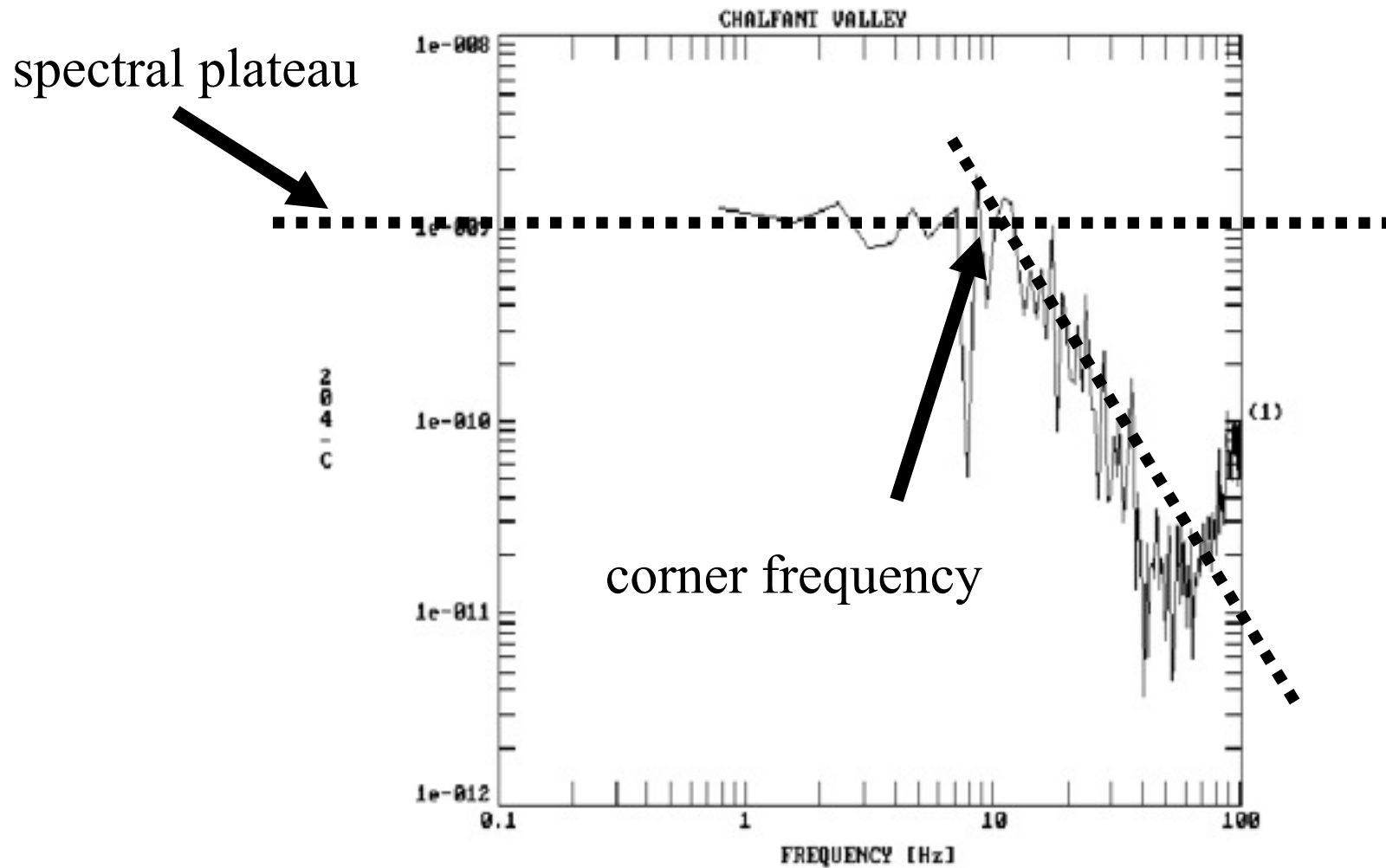


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Displacement spectrum

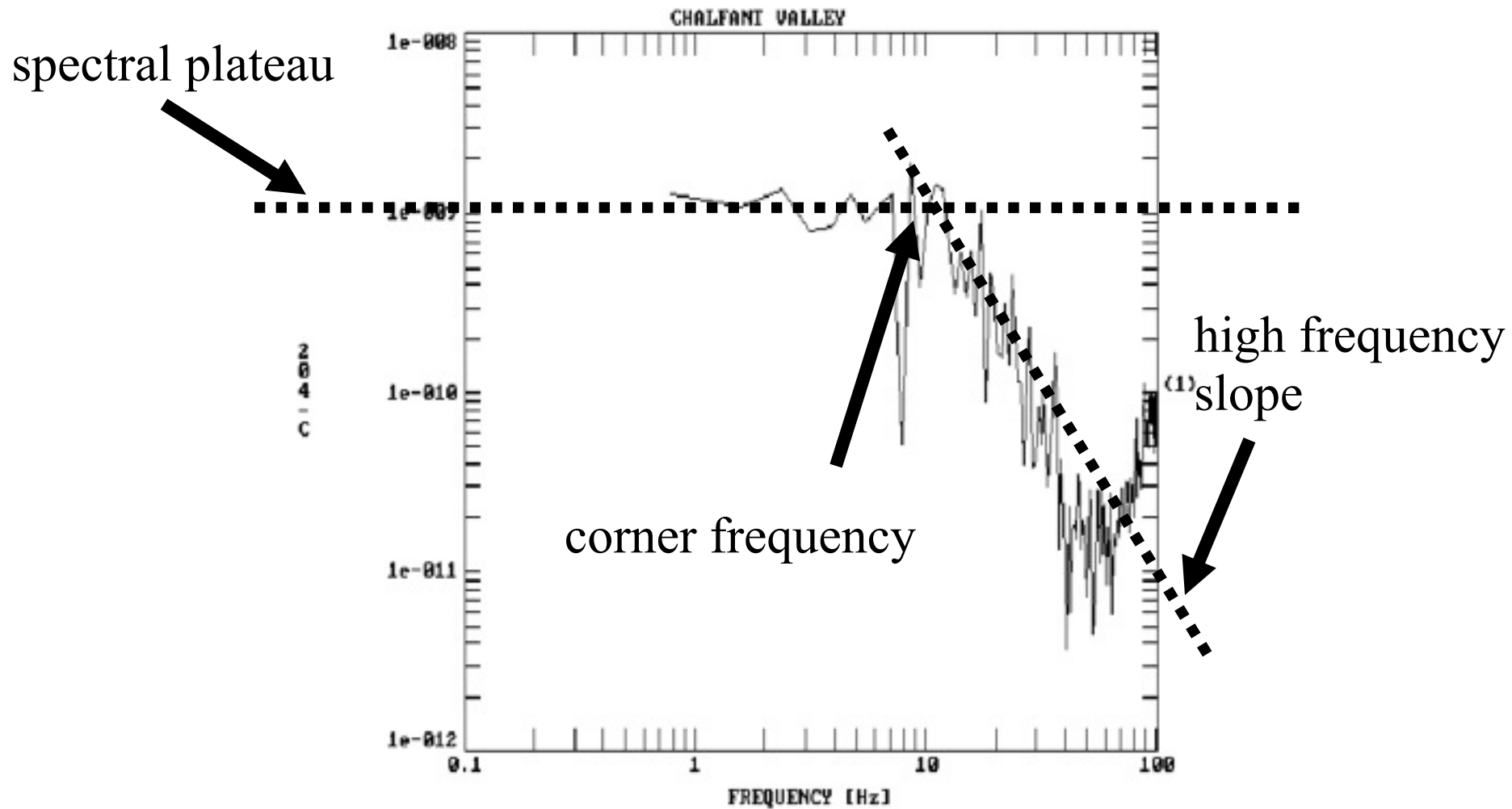


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Seismogram

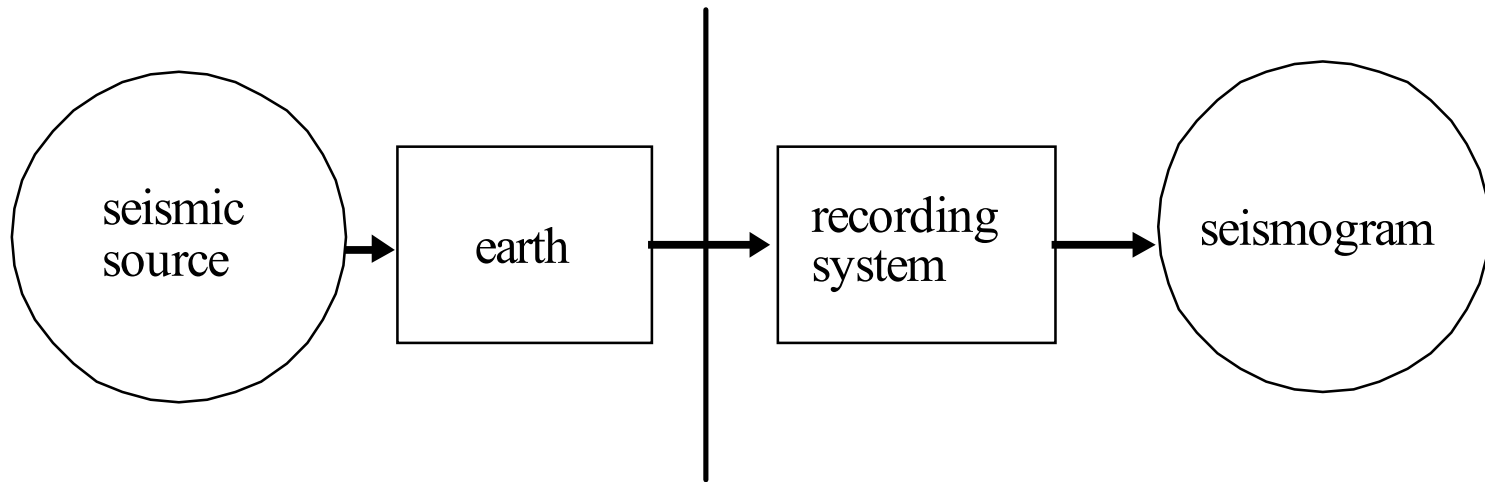
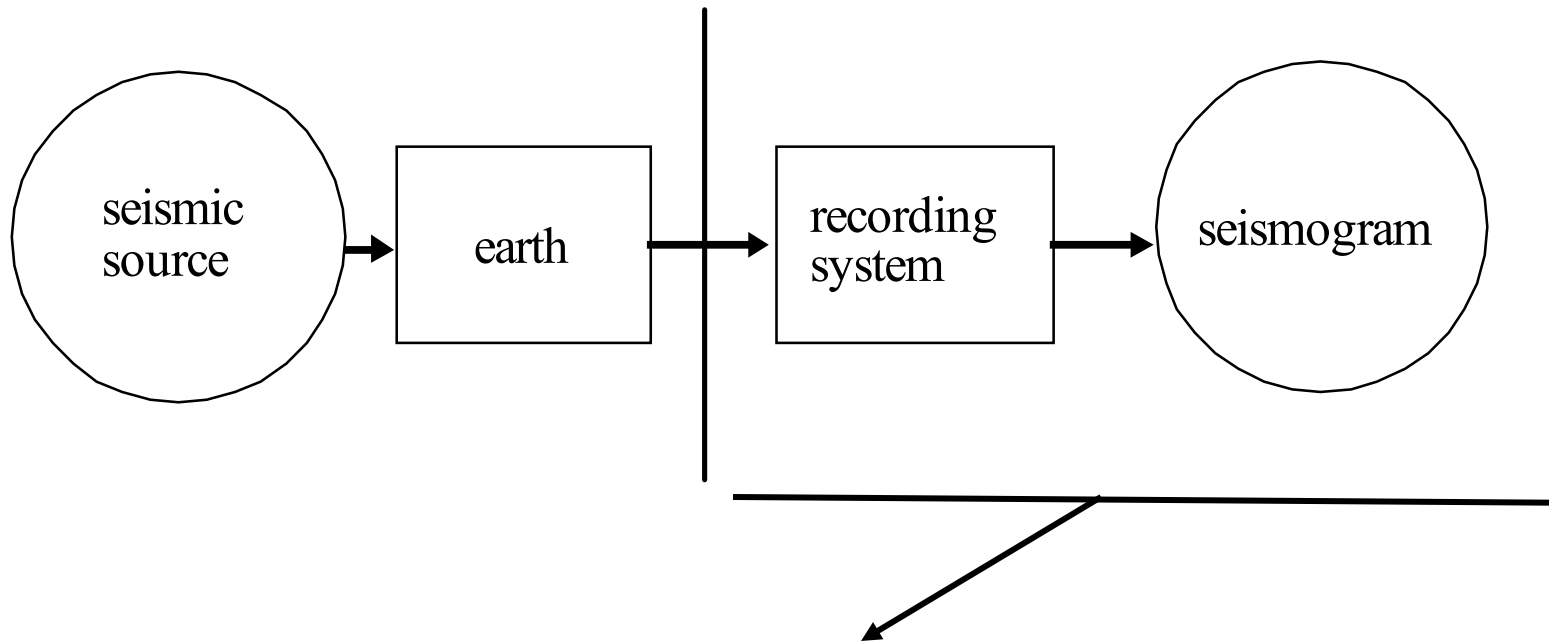


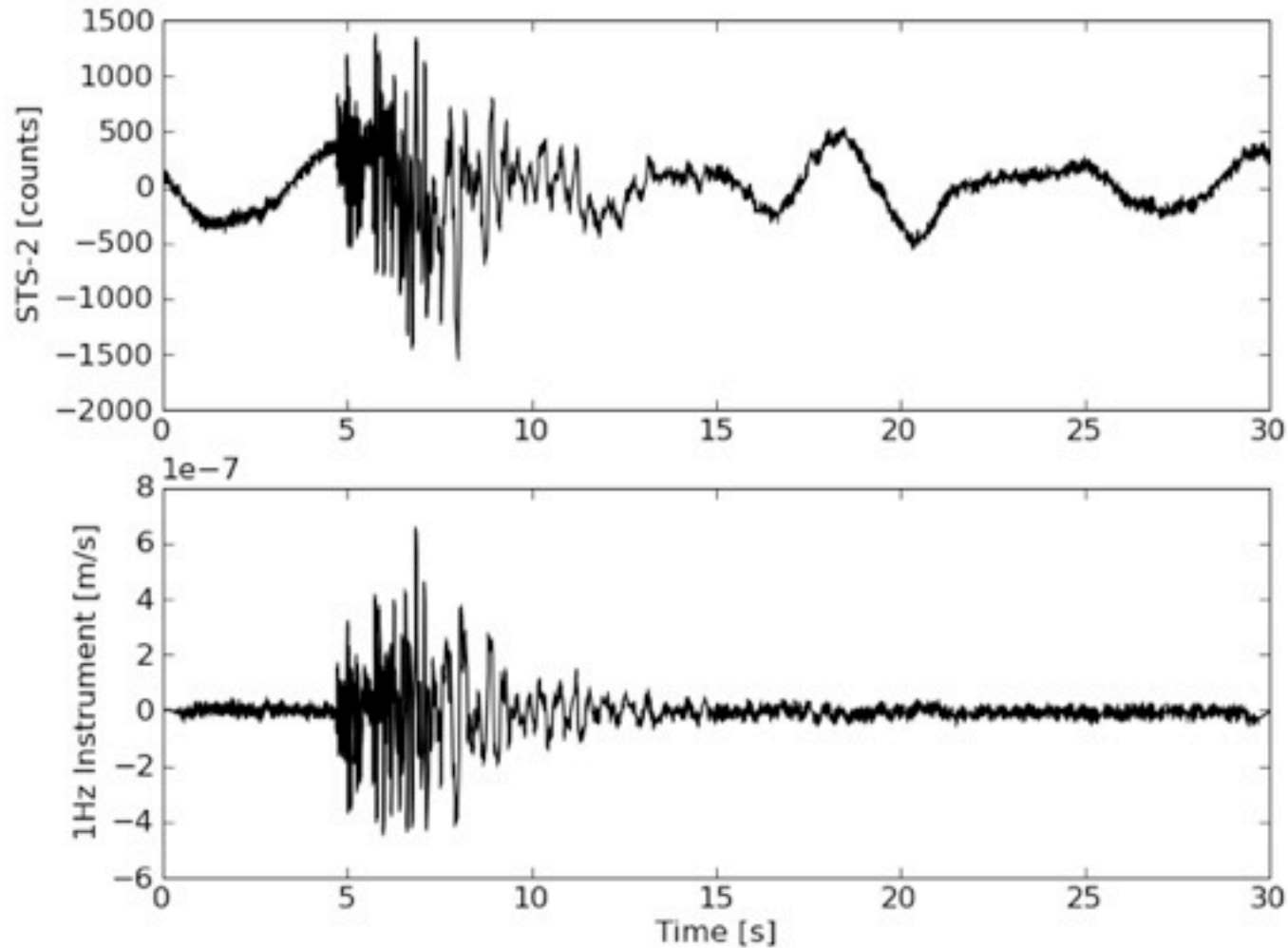
Fig. 1.11 System diagram of a seismogram

Seismogram

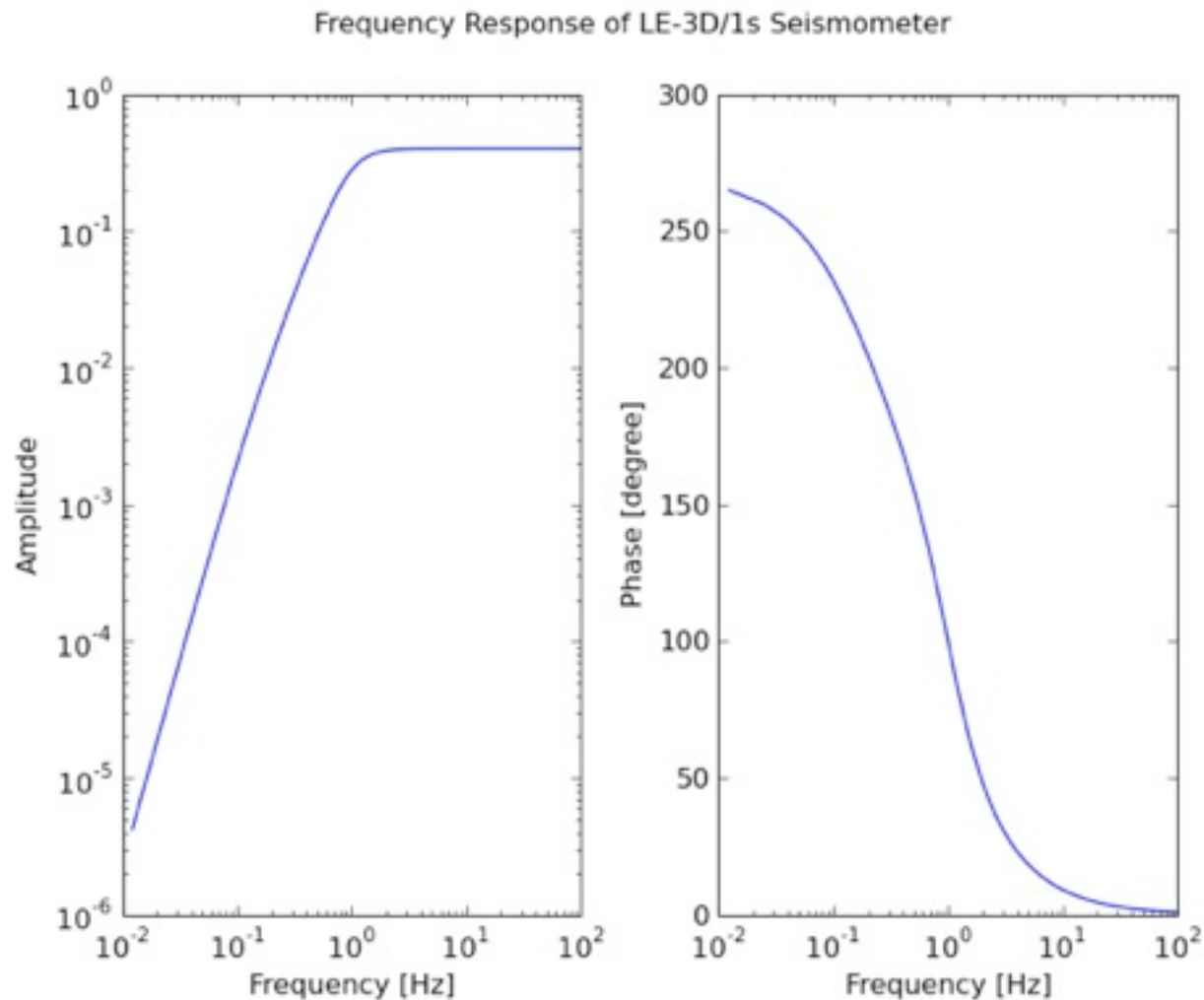


This part is covered by SEED

Simulation Process

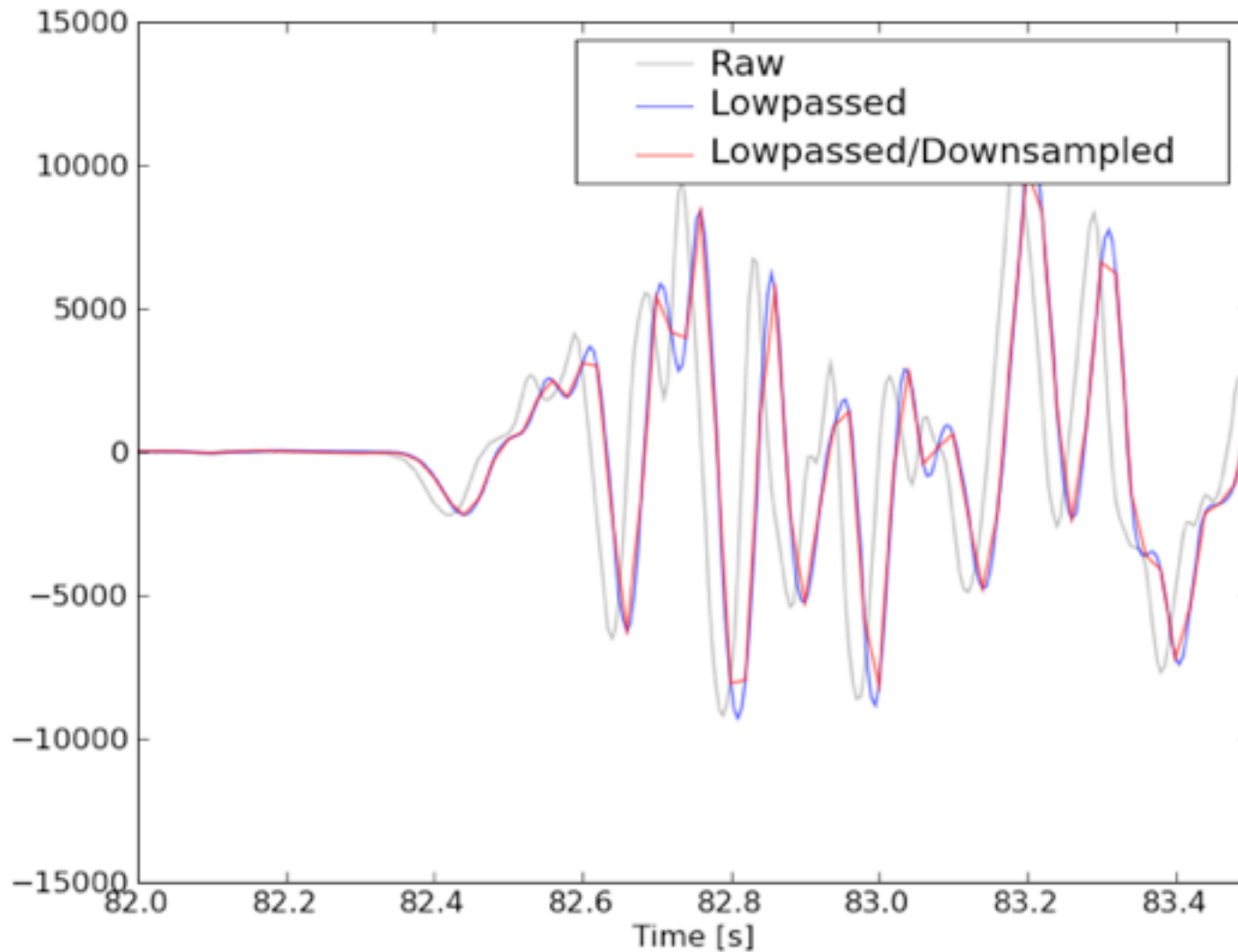


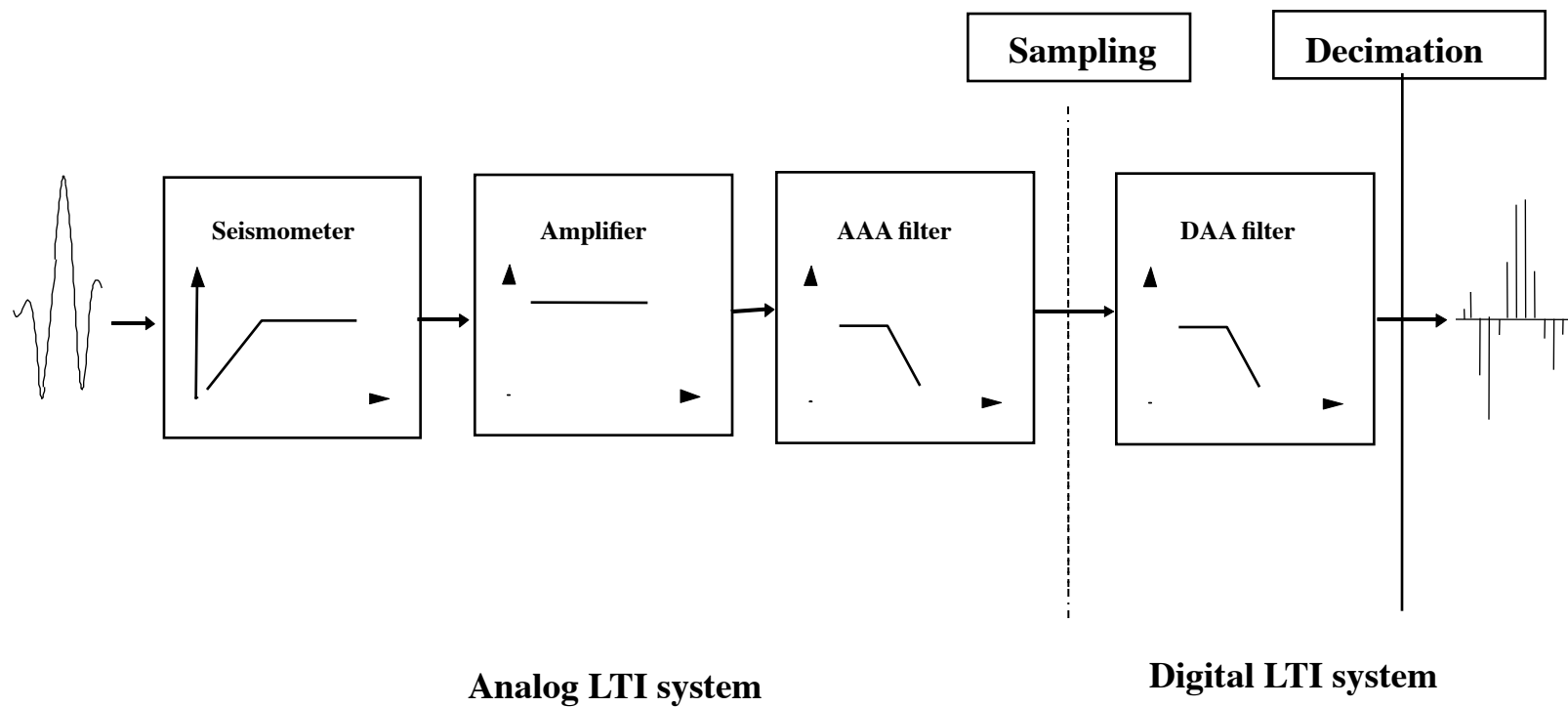
Simulation Process

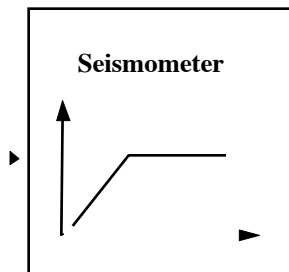


Decimation

2005-10-06T07:21:59.849998Z







```
#      << IRIS SEED Reader, Release 4.4 >>
#
#      ===== CHANNEL RESPONSE DATA =====
B050F03  Station:  RJOB
B050F16  Network:  BW
B052F03  Location:  ??
B052F04  Channel:  EHZ
B052F22  Start date: 2007,199
B052F23  End date:  No Ending Time
#
#      +-----+
#      +      | Response (Poles & Zeros), RJOB ch EHZ |      +
#      +-----+
#
B053F03  Transfer function type:      A [Laplace Transform (Rad/sec)]
B053F04  Stage sequence number:      1
B053F05  Response in units lookup:    M/S - Velocity in Meters per Second
B053F06  Response out units lookup:   V - Volts
B053F07  A0 normalization factor:     6.0077E+07
B053F08  Normalization frequency:     1
B053F09  Number of zeroes:            2
B053F14  Number of poles:             5
#      Complex zeroes:
#      i real      imag      real_error  imag_error
B053F10-13  0 0.000000E+00 0.000000E+00 0.000000E+00 0.000000E+00
B053F10-13  1 0.000000E+00 0.000000E+00 0.000000E+00 0.000000E+00
#      Complex poles:
#      i real      imag      real_error  imag_error
B053F15-18  0 -3.700400E-02 3.701600E-02 0.000000E+00 0.000000E+00
B053F15-18  1 -3.700400E-02 -3.701600E-02 0.000000E+00 0.000000E+00
B053F15-18  2 -2.513300E+02 0.000000E+00 0.000000E+00 0.000000E+00
B053F15-18  3 -1.310400E+02 -4.672900E+02 0.000000E+00 0.000000E+00
B053F15-18  4 -1.310400E+02 4.672900E+02 0.000000E+00 0.000000E+00
```

Definition

- **Filters** or **systems** are, in the most general sense, devices (in the physical world) or algorithms (in the mathematical world) which act on some **input signal** to produce a - possibly different - **output signal**.

Block diagram

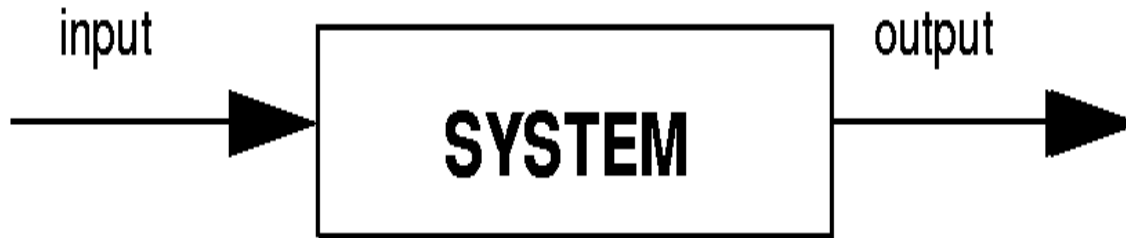


Fig. 1.10 Block diagram of a system

DigSeisTutor demonstration