

# Attenuation of P and S waves in the near surface using uphole data

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## ABSTRACT

Attenuation of seismic waves in the near surface can be significant, and uphole surveys can contribute to its characterization. Possible methods to find the parameter  $Q$  using uphole data are analyzed in this work. The 60 m depth uphole is illustrated in Fig. 1. The sources generate a radiation pattern, illustrated for the 50 m depth example in Fig. 2, together with the horizontal component (S-wave). The estimated attenuation for the 5 m depth shot using the dominant frequency method is illustrated in Fig. 3.

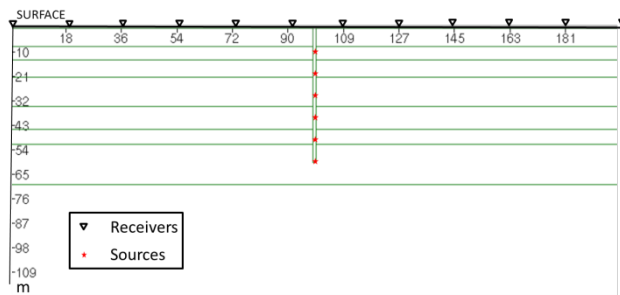


FIG. 1. Uphole design: the sources of energy are inside the borehole and the sensors are on the surface. Energy sources are explosives separated by 5 m from each other, like the distance between receivers. These sources generate P and S-waves in a radiation pattern.

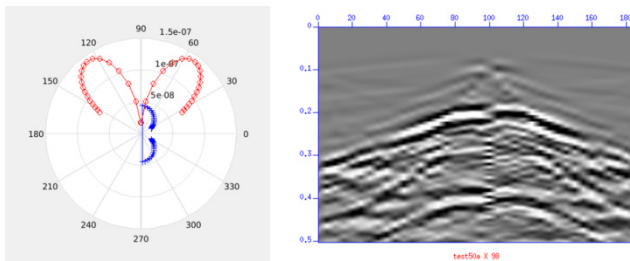


FIG. 2. The radiation pattern for the shot at 50 m depth is shown to the left, and the corresponding synthetic S-wave (horizontal component) obtained with an elastic FD code, is shown to the right. This model does not include attenuation.

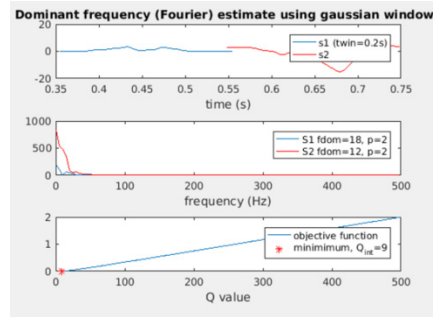


FIG. 3. Example of the application of the Dominant Frequency attenuation method, for the 5 m depth source, and the receivers at 10 m and 90 m offset. A  $Q$  value of 9 was estimated.

Comparing data from different sources has many uncertainties. Even data from the same source is challenging, since besides attenuation the signal is affected by factors such as the radiation pattern, and different wave-paths. Since each shot spans a wide area, attenuation tomography could be an appropriate approach.

Since they have the same source, the uncertainty is reduced, however it is affected by factors such as interfering events caused by the near surface, and the free surface affect. This effect was filtered before the attenuation calculation.