innogeo®

Subsoil and Structure Imaging
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SEISMIC REFRACTION
Study of the underground geological structure

Seismic refraction is a geophysical method for underground surveying based on the study of elastic seismic wave propagation. The goal of the test is to characterise the nature and structure of underground strata by determining their mechanical condition (alteration, splitting, fracturing), thickness and compression wave velocity, which are linked to the mechanical properties of the material.

Compression wave velocities vary from about300 m/s to 6000 m/s when going from a soil to a sound crystalline rock. The more rigid and compact a rock, the higher its seismic velocity. Seismic refraction allows us also to locate tectonic irregularities of the ground (fault). Maximal operational depth for surveying is about a hundred meters, but, in practice, we rarely exceed thirty or so meters.

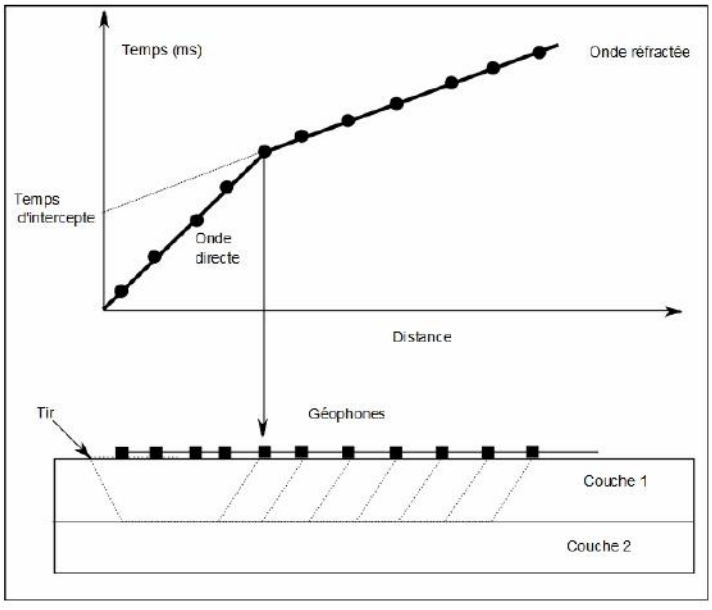
Seismic refraction can used in terrestrial environment as well as in aquatic environment. Its application can only be considered if the seismic velocity increases with depth, if velocity contrasts between strata are distinct enough, and if underground layers are relatively tabular.

The test consist in placing, at surface level, a straight profile of seismic sensors, called seismic spread, connected to a seismic recorder by a measuring cable.

The seismic source is activated at different points along the spread. We then record the travel time between the source and each sensor. The seismic source and the recorder are synchronised so as to measure precisely the time of seismic emission (TB: time break). The source generally consists of a weight fall system, but small explosive charges can be also be used very efficiently, although very regulated.

The high-speed sampling digital recorder also allows us to add up several seismic emissions so as to increase the signal to noise ratio. Typically, we use devices of 12, 24 or 48 sensors, spaced of 5, 10 or 20 meters for depth surveys between 15 and 100 m.

Travel times are transferred on a time-distance graph (see example below).



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Interpretation led by the plus-minus method enables us to map out underground strata and create a seismic cross-section (example below; velocities are in m/s). Control mechanical drillings are necessary to adjust the depth of each encountered strata and reduce uncertainties inherent to the method.