



## **High-resolution velocity field imaging around a borehole: Excavation Damaged Zone characterization**

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The excavation of a deep underground structure induces a stress field redistribution that may create an Excavation Damaged Zone (EDZ). The study of the EDZ is essential in the framework of nuclear waste storage, where EDZ may constitute a preferential pathway of stored materials towards the biosphere. Analysis of ultrasonic wave propagation across the rock media around the excavation is generally used to characterise the EDZ.

In the framework of the NF-PRO European program, an inversion method and a specific probe have been developed to image the velocity field in the borehole vicinity, in order to characterize the EDZ. The probe is composed by a couple of sensor able to sound the velocity in depth around the borehole wall. The original features of the probe rest on the automatic sensors displacement in rotation and in translation with a precision of  $0.5^\circ$  and 0.2 mm respectively allowing to building velocity images with a theoretical resolution of 2.16 megapixels per plan.

This method has been preliminary applied on a multi layer test bed to validate and optimise the experimental and numerical procedures. Based on those results, an in situ experiment has been run in the Meuse/Haute-Marne Underground Research Laboratory (URL) in France. Dedicated to the safety assessment of nuclear waste storage in the Callovo-Oxfordian argillaceous layer.

A specific tomographic inversion, based on the global matrix method and the bedding rays, has been used to process the experimental data. The method highlighted finely the velocity perturbation caused by a 86 mm diameter borehole. The damage zone extends until 0.175 diameter of depth with an anisotropic damage pattern oriented in

the regional stress field. The measured velocity field around this borehole are well correlated with the one provided by numerical modelling.

This approach, performed on several boreholes, allows estimating the EDZ and its variability at a tunnel or gallery scale.