



## **Seismic response analysis of NAGRA-Net stations using advanced geophysical techniques**

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In cooperation with the National Cooperative for the Disposal of Radioactive Waste (Nagra), the Swiss Seismological Service (SED) has recently completed the installation of ten new seismological observation stations, three of them including a co-located borehole sensor. The ultimate goal of the project is to densify the existing Swiss Digital Seismic Network (SDSNet) in northern Switzerland, in order to improve the detection of very-low magnitude events and to improve the accuracy of future location solutions. This is strategic for unbiased monitoring of micro seismicity at the locations of proposed nuclear waste repositories.

To further improve the quality and usability of the recordings, a seismic characterization of the area surrounding the installation area was performed at each site. The investigation consisted of a preliminary geological and geotechnical study, followed by a seismic site response analysis by means of state-of-the-art geophysical techniques. For the borehole stations, in particular, the characterization was performed by combining different types of active seismic methods (P-S refraction tomography, surface wave analysis, Vertical Seismic Profiling - VSP) with ambient vibration based approaches (wavelet decomposition, H/V spectral ratio, polarization analysis, three-component f-k analysis).

The results of all analyses converged to the definition of a mean velocity profile for the site, which was later used for the computation of engineering parameters (travel time average velocity and quarter-wavelength parameters) and the analytical SH-wave transfer function. Empirical site-amplification functions are automatically determined for any station connected to the Swiss seismic networks. They are determined based on building statistical models of systematic site-specific effects in recordings of small earthquakes when compared to the Swiss stochastic ground-motion model. Computed site response is validated through comparison with these empirical functions, and finally used to correct recordings before further processing.