Surface-wave analysis for pseudo-2D Vs profiling on a granite-micaschists contact at Plœmeur hydrological observatory, France.

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Water supply in crystalline context is mainly relying on surface reservoirs, because of the low porosity (limited storage capacity) and permeability (limited yields) of crystalline rocks. As a result of contamination risks, groundwater resources are more and more under pressure. Multiple fracture system and weathering may increase rock permeability at the kilometric scale, localising water flow. Wells are productive only when connected to the main fracture system, therefore, the high heterogeneity implies well position to be chosen carefully. Estimating the mechanical properties of the aquifer system may considerably help the delineation of the weathered and fractured areas prior to drilling implementation.

Several geophysical surveys have been performed on a site located at a contact between granites and micaschists in order to characterise its near-subsurface. High productivity wells are located next to a sub-vertical fracture system which is intersecting a horizontal system, allowing drainage of a large area. Seismic methods are more particularly proposed to focus on the contact between granite and micaschists and to estimate the shallow mechanical properties of the aquifer system. The combined interpretation of Vp and Vs can help the characterisation of both weathered layer and bedrock in a crystalline context. From a practical point of view, measurements of Vs remain delicate because of well-known SH-wave generation and picking issues in SH-refraction seismic methods. Indirect estimation of Vs can be achieved in a relative straightforward manner by using surface-wave prospecting methods, as an alternative to SH-wave refraction tomography. But such approach still deserves both theoretical and methodological developments.

We performed simultaneous P-wave refraction tomography and surface-wave profiling on a line intersecting the contact zone, along with SH-wave refraction. As for surface-wave profiling, we used offset moving windows and dispersion stacking techniques to narrow down the lateral extent of dispersion measurements and invert dispersion curves for each moving window. We retrieved a pseudo-2D Vs section of the studied medium that we compared with SH-wave tomography results. Among the three different window sizes used for surface-wave profiling (6, 12 and 24 traces), the pseudo-2D Vs section obtained with the 6-trace window showed the best agreement with the Vs tomography profile, retrieving the most of the observed lateral variations. These variations were also consistent with those observed on the Vp profile and on an ERT profile acquired along the same line, thus validating the best-suitable window size for the surface-wave profiling.