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GPR Amplitude and Phase Versus Offset (APVO) studies for fracture characterization

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The stability assessment in rock fall hazard is generally based on surface geological observations and mechanical analyses or numerical computations. Its reliability suffers from the lack of information within the prone fall rock mass, particularly about the geometry and the properties of the fracture networks. In this context, geophysical methods and particularly GPR data are able to provide the desired information. In the present study, we present GPR data recorded on the wall of a prone fall limestone cliff, which was mined afterwards. Combined with CMP data, they provided images of the geometry of the main fractures, which were confirmed afterwards by borehole measurements. Although helpful in the choice of mitigation works, no quantitative information about fracture properties was deduced from these images. Beside velocity, CMP data contain information which is generally no used, i.e. Amplitude and Phase variation of the reflectivity of a given reflector as a function of Offset (APVO). In a second part of this work to analytical and numerical tests were performed to evaluate the potential of these curves for characterizing fracture properties, considering thin layer approximation. For this, we tested the efficiency of a neighbourhood inversion algorithm on analytical and numerical data reproducing a typical CMP data acquisition. We notably tested the sensitivity of different acquisition modes (TE and TM) and the effect of their joint inversion on a air-filled crack embedded in limestone formations, considering a large number of crack apertures. We also evaluated the normalization choice of the APVO curves. Numerical computations also allowed evaluating the processing tools which are efficient to derive correct APVO curves from CMP radargrams. These encouraging preliminary results are the first steps prior to field applications on different test sites.