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Identification of deformation stages in rocks by means of weak electric current emissions using wavelet analysis

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Experimental data from a variety of rock materials have shown that uniaxial compressional stress results in weak electric current emissions. In this work marble samples that are subjected to abrupt stress steps up to fracture are used to differentiate between the electric signals recorded in each stage of deformation of the material.

Wavelet Transform supports unequally spaced time-scale analysis and has been proved useful for the analysis of electric signals, because it provides a better approach for both their high and low scale components. Furthermore it is used for the localization of the signal energy, which is related to the energy transferred to the sample in the form of compressive stress.

More specifically Continuous Wavelet Transform with Daubechies 10th as mother wavelet was used for the analysis of the signals to get better frequency resolution. Low scale components that correspond to high signal frequency are prominent in the first stress steps when initial microcracks are created. In the following steps the already created microcracks are clustered to macrocracks and therefore only high scale i.e. low frequency components appear in the signal. Both high and low frequency components are recorded again in the final stage of the experiments when the samples are led to failure.

Thus, it was found that wavelet analysis facilitates showing up and identifying the impact of the evolution of the material deformation and crack formation on the recorded electric signal.