Advanced Acoustic Emission Analysis of Rock Fracture

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To investigate brittle failure in rocks, we use a 12 channel transient recording system (DAXBOX, Prökel). The system stores full waveform of Acoustic Emission (AE) signals at 10 MHz sampling rate with an amplitude resolution of 16 bit. Dead time between consecutive records is zero, so that even at high AE activity continuous recording of practically all AEs emitted during an experiment is possible. Advanced analysis software is used to split signals into discrete AE events and also to pick up onset time of signals automatically, which is included in the inversion procedure to determine AE hypocenter locations. Accuracy of the location procedure is high with an absolute location error of 2.5 mm. First motion polarity of signals is used to separate AE source types in tensile, shear and collapse events. Cylindrical samples of granite and sandstone of 50 mm diameter and 100 mm length were fractured at confining pressures of 5 - 40 MPa. We compared fracture propagation in uniformly loaded samples with fracture propagation from stress concentrations of steel indenters or notches. Regardless of applied boundary conditions, the process of brittle failure of rocks can be separated into two stages. In the first stage accumulation of homogeneously distributed uncorrelated cracks occurs in the sample volume. Most of AEs at this stage were identified as tensile sources. During the second stage the fracture propagates through the sample and shear cracks are dominant. Finally, microcracks form an interconnected network. Tensile cracks become less important and they are registered more frequently at the tip of propagating fault.