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Precusory Changes in B-Value of Acoustic Emissions in Rocks Stressed to Fracture: A Case Study

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Abstract

The amplitude distribution of acoustic emissions (AE) which are produced from solids undergoing brittle facture show a negative straight line slope and it is called the b-value. Generally it ranges from 0.5 to 2.5 and is mostly found to be ~ 1.0 over a large loading regime. As the impending failure approaches, the b-value decreases sharply and can even undergo some short-term anomalies in accordance with the physical processes of crack growth in the test solid. We have recently carried out compressive deformation and failure studies by concurrently monitoring and recoding the strain AE in some of the seismically active rocks of Gujarat. Among various parameters, the stress-induced changes in AE b-value have been investigated in detail. We have been able to track and analyze the formation and development of all the various stages of stress-induced microcracking until the final failure occurred in the test rock. The results obtained show that the dilatancy (inelastic volumetric strain due to the formation and growth of new microcracks) commences quite early in these rocks with b-value decreasing sharply from its base value. Furthermore, the transformation from unstable cracking to crack-coalescence at stresses close to failure is also relatively fast in them. These results have some important applications in understanding the fracturing mechanisms in rock and to apply them for mining engineering and seismic monitoring studies.