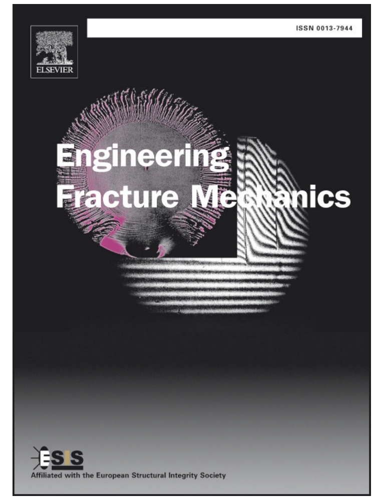
Accepted Manuscript



Acoustic Emission and Kinetic Fracture Theory for Time-Dependent Breakage of Granite

Ryan A. Winner, Guanyi Lu, Romain Prioul, Gallyam Aidagulov, Andrew P. Bunger

PII: S0013-7944(18)30016-X
DOI: https://doi.org/10.1016/j.engfracmech.2018.05.004
Reference: EFM 5978

To appear in: *Engineering Fracture Mechanics*

Received Date: 10 January 2018
Accepted Date: 4 May 2018

Acoustic Emission and Kinetic Fracture Theory for Time-Dependent Breakage of Granite

Ryan A. Winner[1,a], Guanyi Lu[b], Romain Prioul[c], Gallyam Aidagulov[d], Andrew P. Bunger[a,b,*]

[a] *Department of Chemical and Petroleum Engineering, University of Pittsburgh, Pittsburgh, PA, USA*
[b] *Department of Civil and Environmental Engineering, University of Pittsburgh, Pittsburgh, PA, USA*
[c] *Schlumberger-Doll Research, Cambridge, MA, USA*
[d] *Schlumberger Dhahran Carbonate Research, Kingdom of Saudi Arabia*

Abstract

Earthquakes, mine failures, and initiation of hydraulic fractures have all been associated with time-delayed breakage of rocks subjected to loads insufficient to incur instantaneous failure. To better model and identify failure precursors for rocks under these so-called static fatigue conditions, Acoustic Emission (AE) was monitored in beams of Coldspring Charcoal Granite subjected to constant three point loading. As a result of varying the magnitude of the loading, the times to failure range from $O(10^1) - O(10^5)$ seconds. The experiments show a number of consistencies in the AE data. In all cases the event rate exponentially declines for a period that is about 0.4-0.6 of the total time to failure. This period is followed by a period in which the event rate exponentially increases. The total number of events generated during these two periods is also consistent among the experiments. Motivated by these observations, we propose a modified kinetic fracture theory that captures both the period of event rate decline and the period of event rate increase. It does this by firstly accounting for early time depletion of available bonds for breakage, similar to previous models. The model also accounts for generation of critically stressed bonds in the vicinity of previous

*Corresponding author
Email address: bunger@pitt.edu (Andrew P. Bunger)
[1] Now at Harold Vance Department of Petroleum Engineering, Texas A&M University, College Station, TX, USA