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Extending non-fatigue Mode I subcritical crack growth data to subcritical fatigue crack growth: Demonstration of the equivalence of the Charles' law and Paris law exponents

Russell Keanini (1) and Martha-Cary Eppes (2)

(1) University of North Carolina at Charlotte, Charlotte, United States (rkeanini@uncc.edu), (2) University of North Carolina at Charlotte, Charlotte, United States (meppes@uncc.edu)

Paris's law connects fatigue-induced subcritical crack growth and fatigue loading. Environmentally-driven subcritical crack growth, while a random process, can be decomposed into a spectrum of cyclic processes, where each spectral component is governed by Paris's law. Unfortunately, almost no data exists concerning the Paris law exponent, m; rather, the great majority of existing sub-critical crack growth measurements on rock have been carried out via Mode I tensile tests, where corresponding data are generally correlated using Charles' law, and where the latter, similar to Paris's law, exposes a power law relationship between crack growth rate and stress intensity. In this study, a statistical argument is used to derive a simple, rigorous relationship between the all-important Paris law and Charles law exponents, m and n. This result has a significant practical implication: subcritical fatigue crack growth in rock, driven by various random environmental weathering processes can now be predicted using available Mode I stress corrosion indices, n.