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Change of crackling noise in granite by thermal damage: Monitoring nuclear waste deposits

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Abstract

High-sensitivity detection of acoustic emission from granite under uniaxial stress, together with advanced statistical analysis, shows changing collapse mechanisms when a sample is pre-heated. Massive microstructural changes occur at temperatures >500 °C while low-temperature (<<500 °C) treatment leads to scale invariant crackling noise with a mixed fix-point behavior. After treatment at higher temperatures, the collapse occurs via acoustic signals that show energy distributions with systematic deviations from the Gutenberg-Richter law while the Omori's and Båth's laws are not influenced by the thermal treatment. The granite samples stem from the site in the Beishan mountains where a new burial site for nuclear waste will be constructed. According to the 13th Five-Year Plan of the P.R. China, Chinese nuclear power installed capacity will reach 58 million kilowatts in 2020 and produce about 3200 tons of high-level nuclear waste every year. Monitoring the stability of the host rock at high temperatures becomes hence a key issue. Our analysis can serve as a blueprint for a protocol for continuous monitoring of the burial site.

Keywords: Crackling noise, granite, thermal damage, acoustic emission