PRESSURE STIMULATED CURRENTS (PSC) IN ROCK SAMPLES: A LABORATORY STUDY OF SEISMOELECTROMAGNETIC EFFECTS

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Seismoelectromagnetic Effects (SEME) has long been evaluated, but it has proven difficult to construct a rigorous theory to describe their generation and expected characteristics. During last years numerous laboratory experiments demonstrating the generation of SEME have been conducted, supporting their existence. The underlying physical mechanisms proposed to explain these observations are mainly the piezo-electric and electrokinetic effects. The piezoelectric effect, cannot explain seismoelectromagnetic effects generation from non-piezoelectric rock specimens. Streaming potential can be generated in many kinds of saturated rocks, but the fracturing of dry rocks also produces SEME. Therefore, piezoelectric and electrokinetic effect may not be the basic originators of fracture precursory phenomena observed in the laboratory. Microfracturing electrification can be another candidate physical cause for explaining SEME. Thus, series of laboratory experiments based on that concept conducted on dry marble samples under stress. The marble samples were subjected to uniaxial compressional stress with constant and variable stress-rates, in both the elastic and the plastic region. During the experiments, different forms of PSCs were observed, demonstrating that the mechanical status (i.e. Young's modulus) of the material is clearly dependant on the applied stress rate, decreasing in frequency and intensity with increasing damage during repeated loading cycles. We clearly show that the scaling factor between the emitted current and the stress rate is constant in the elastic range, but linearly dependant with stress in the plastic one. The above results can be attributed and sufficiently explained by combining a theoretical model involving microfracturing and the motion of charged edge dislocations (MCD) as the primary electrification mechanism with models describing the behavior of elastic constants in loading samples.