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Modified Omori Law in Aftershocks Sequences from Laboratory Hydraulic Fracture Experiments

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Modified Omori Law is commonly observed in geological aftershocks. Recently there were indications of a wider significance of the Modified Omori Law when aftershocks are observed after different types of laboratory fracture experiments. This study examines five aftershocks sequences recorded over a 24-hour period after the shut-in was applied to the hydraulic fracturing experiments of mortar blocks. The five aftershocks sequences are consistently treated with the same statistical procedure. Since the times of aftershocks are governed by the Poisson process, the maximum likelihood method is adopted to fit the aftershock sequences with both the Modified Omori Law and the simplified Omori law characterised by the zero time shift. It is shown that the Modified Omori Law is a better model for the sequences considered here based on the coefficient of determination and the Akaike Information Criterion. Both the decay exponent and the time shift estimated from the maximum likelihood method are in the expected range when compared with the geological aftershocks. From the statistical similarities between the geological and laboratory aftershocks, it can be inferred that there is a unified mechanism which governs the generation of aftershocks across the scale. The power law decay of frequency of aftershocks is governed by the stress relaxation process caused by gradual reduction of the moduli produced by the static fatigue microcrack accumulation. It is suggested that small sliding zones might develop after the shut-in based on the dependence of the decay exponent on the spatial distribution of microcracks.