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Leading aftershocks and cascades: two possible stress release processes after a main shock

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Three series of aftershocks in Southern California, associated with the main shocks of Landers (1992), Northridge (1994) and Hector Mine (1999), are interpreted as the superposition of a lasting relaxation stress process and numerous short episodes of sudden stress release. The set of aftershocks belonging to the lasting process are designed as leading aftershocks and its rate decays with time, fitting well to the classical Omori's law. The remaining aftershocks are assigned to the different episodes characterised by sudden release of stresses, each of them being designed as a cascade. Cascades are characterised by four basic properties. First, the number of aftershocks belonging to a cascade is submitted to remarkable time fluctuations. Nevertheless, it is observed a positive trend in the number of aftershocks with respect to the elapsed time measured since the origin time of the main event. Second, the rate for aftershocks belonging to a cascade can be assumed constant. Third, a power law quantifies the rate for every cascade, with the elapsed time since the main event to the beginning of the cascade being the argument of this power law. Fourth, the validity of the Gutemberg-Richter law is preserved both for the set of leading aftershocks as for the set of tremors associated to cascades. Given that the number of available aftershocks for the three seismic crisis is very high (exceeding 10,000 tremors), a detailed analysis of cascades is available.