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Role of fluid on earthquake occurrence: Example of the 2019 Ridgecrest and the 1997-2016 Central Apennines sequences

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This paper focuses on the study of the temporal evolution of seismicity and related fluid migration following major earthquake sequences occurred in the central Apennines and Eastern California Shear Zone over the last two decades: The 1997 Colfiorito sequence, the 2009 L'Aquila sequence, the 2016 Amatrice-Norcia sequence and the 2019 Ridgecrest sequence. The availability of different high-quality seismic catalogs offers the opportunity to evaluate in detail the temporal evolution of the earthquake's size distribution (or b value) and estimate the effect of the fluid flow process in triggering seismicity. For all seismic sequences, the b value time series show a gradual decrease from a few months to one year before mainshocks. The gradual decrease in the b value is interpreted in terms of coupled fluid-stress intensity as a gradual increase in earthquake activity due essentially to the short-term to intermediate-term pore-fluid fluctuations. Based on laboratory experiments results, the observed short–term fluctuation of b value is presented here as an accelerating cracks growth due essentially to the fluid flow instability. Despite that the occurrence of seismic precursors could have been predictable in areas with high dense seismic networks, the different b value time series show a difficulty to establish a correspondence between the duration of the foreshock activity and the magnitude of the next largest expected earthquake. This may explain that the spatial and temporal evolution of fluid migration controls the size of the ruptures.