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Anatomy of an earthquake multiplet active over several years in the western part of the Corinth rift

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The Corinth rift is one of the most seismically zones in Europe. The seismic activity is characterized by numerous multiplets. A multiplet is a group of earthquakes with similar waveforms resulting from close location and focal mechanism. Multiplets are often associated with small asperities and can be seen as repeated ruptures due to transient forcing as silent creep or pore pressure front diffusion. Detailed analysis of the multiplets in the Corinth rift is an opportunity to better understand fault dynamics, small earthquake rupture mechanics and coupling with aseismic processes.

We focus on a large multiplet (500 x 500 m) located under the northern coast of the Corinth gulf at 8 km depth. This multiplet was more or less regularly active between 2000 and 2007. During this period, 56 events were recorded. The most observed recurrence time is of 23 days but can vary between 1 and 115 days.

We estimate the source parameters of the 56 earthquakes by following a two-step approach based on the analysis of the displacement seismic spectrum. First, the scalar seismic moment and the magnitude are computed from the amplitude of the low frequency part (plateau) of the P and S spectrum. Second the source size is calculated from the P and S corner frequencies. Corner frequencies are determined by inverting spectral ratio (i.e. the ratio between the spectra of two collocated earthquakes). The advantage of working with spectral ratio is to eliminate the trade-off between corner frequency and anelastic attenuation if Q factor is poorly known. Spectral ratio inversion is performed following a Bayesian formalism.

The magnitudes scale between 1.20 and 2.76. The seismic activity is characterized by relatively high magnitude events (b-value = 0.82) until the mainshock (mid-2003) and low magnitude events after (b-value = 1.21). The source radii globally range between 50 and 200 m. The source overlapping is strong; some fault patches have ruptured up to19 times which has produced a cumulated coseismic displacement of 1 cm. We observe a rupture in the scaling law: most of the events have a source radius around 80 m with a seismic moment scaling over 3 orders of magnitude.

Finally we compare our results with rate-and-state 3D asperity modeling in order to propose a mechanical model explaining the spatio-temporal dynamics of the multiplet (seismic asperity embedded in a creeping fault surface vs. locked fault surface).