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Source scaling of aftershocks following the 2009 Mw 6.3 L'Aquila earthquake (Central Italy) recorded at an underground array

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Most of the studies about source parameters of large-to-small earthquakes uses far-field surface recordings from regional seismic network. Seismic noise, site and path effects can strongly bias the earthquake source spectral parameters, particularly for earthquakes of low-to-moderate magnitude. The use of seismic signals recorded in underground environment, where seismic noise is reduced, and the application of Spectral Ratio Approach (SRA) between similar events are strongly recommended for the investigation of source parameters such as stress drop and corner frequency. We show the results obtained on 7500 earthquakes of low-to-moderate magnitude ($0.5 \leq$ ML ≤ 4.1), recorded at the underground array Underseis located at 1.4 km depth near the town of L'Aquila. First we identified 290 clusters of similar seismic events by applying a cross-correlation based criterion, then we apply the spectral ratios approach among the events of each cluster to estimate the source parameters. The most of clusters are located close to the main shock of April 6, 2009, at a distance of 15-25 km from the array. A system of SW-dipping faults reasonably fit the spatial distribution of earthquakes, in agreement with the results found in other works. For each cluster we apply SRA to evaluate source spectral parameters such as the corner frequencies by using a grid search algorithm and consequently the stress drop. The S-wave spectra averaged on 7 stations of the array were used to evaluate spectral ratios. The redundancy of solutions obtained by considering the spectral ratios among all possible pairs of similar events is used for a more stable estimate of the corner frequency. The final value of corner frequency for each event was obtained by applying three different methods: i) by taking the mean between all corner frequencies fc, ii) the weighted mean based on standard deviations associated to each fc and iii) the weighted mean based on seismic moment difference between the two events involved in the spectral ratio. The seismic moment was estimated from the low frequency part of the averaged S-wave spectra. The stress drop vs seismic moment trends (weighted and non-weighted mean methods) show non self similar behavior for the investigated range of magnitude ($0.5 \leq$ ML ≤ 4.1). The apparent stresses clearly increase from 1 to 200 bars with seismic moment increasing from 1010 to 1014 Nm. The power of seismic moment scale dependence from stress drop is estimated in the range 0.5 - 0.7. Preliminary results show that array underground data and SRA are particularly suited to investigate the spectral source parameters of small earthquakes.