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Characterization of the closely-spaced earthquakes along the North Anatolian Fault Zone, NW Turkey

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Investigating the location and source properties of earthquakes using relative seismological techniques reduces the influence of wave propagation and site effects on seismic data yielding significant improvement in the measurements. We search for earthquakes with similar waveforms in order to identify spatiotemporal clusters as well as repeating earthquakes along the 1999 Izmit rupture zone and its transition into the Sea of Marmara region. Earthquakes in each cluster are relocated inverting cross-correlation derived relative travel times using the double-difference method in order to characterize the spatiotemporal distribution of co-located microearthquakes with a relative location accuracy comparable to or better than the source size. High-precision relative hypocenters define the geometry of each fault patch, permitting a better understanding of fault kinematics and their role in local-scale seismotectonics along the region of interest. Earthquake source parameters are measured using the multi-window spectral ratio technique (MWSR). The technique eliminates the effect of radiation pattern and path terms for co-located events. Spectral-ratio-derived source parameters are also used to determine path-averaged Q for each cluster by finding the value of Q that restores the raw spectrum to the ω-squared model with the corner in the location determined by the MWSR method. The most developed sequence we observed represents a NNW-SSE oriented 78° SW dipping splay fault that is neighboring the northernmost segments of NAFZ in Çınarcık Basin. The failure has initiated at the junction that connects the splay fault to the main branch of NAFZ and then systematically migrated into the splay fault within 20 hours. The results show that the temporal sequences represent the failure of adjacent fault patches, and do not indicate a repetitive failure of a particular area. We observe the migration of earthquakes at rates of 0.7 to 2.3 km/day.