

## **Detection of repeating earthquakes and the variation of source characteristics**

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Idealized repeating earthquakes are events that have exactly the same fault area and slip. In reality, the fault area and slip are somewhat variable. In this study, I define repeating earthquakes (repeaters) as earthquakes whose slip areas overlap and discuss about the variation of the repeater source characteristics.

The repeating earthquake selection is usually based on the event location and/or event waveform similarity. We investigated how the frequency distribution of inter-event time changes with the difference in the waveform similarity thresholds. The inter-event time characteristics suggest low similarity threshold in waveform result in the inclusion of triggered sequence (aftershocks) that occurred close to each other but not overlapping.

Even after eliminating aftershock sequences by an appropriate similarity threshold or precise hypocenter location, the repeating earthquakes still have large variation in their source characteristics. Smaller earthquakes are sometimes contained within the rupture area of larger repeater sequences suggesting earthquake faults including a hierarchical (multi-scale) structure of the earthquake source area enables partial ruptures of the slip area of larger earthquakes by smaller earthquakes. The activity of smaller earthquakes in the rupture areas of larger repeaters sometimes show temporal change related to the earthquake cycle of the largest repeaters. The behaviour of such repeaters may provide a tool to monitor the evolution of fault stress/strength during earthquake cycle.

The loading rate change to the repeating earthquake sequences also introduce variation in the source characteristics of repeating earthquakes. The large postseismic slip of 2011 Tohoku-oki earthquake revealed that larger repeating earthquakes than before occurred for many sequences after the Tohoku-oki earthquake. It suggests that the area where aseismic slip (creep) was occurring under slow loading rate can have seismic slip under faster loading rates. Such mechanism of changes in slip behaviour is important not only for the repeating earthquakes but also for the mechanism to determine the source size of earthquakes in general.